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OSSEOUS DYSTROPHIES [1]

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INTRODUCTORY

IN considering the presentation of the subject the writers have not felt that they could assume to be presenting a scientific discovery or any startling contribution to the subject of bone disturbances. Rather, it is that, having our own interest and enthusiasm excited, there might be something in our observation worth passing on. Then, too, we have followed the line of thought which Dr. Bloodgood has had on the subject of bone tumors, and considered that in such rather uncommon disorders positive progress and standardization of medical knowledge will come only from the net effect of all possible observations or contributions, wherever material is found. In this subject of diffuse skeletal disorders it has seemed that medical knowledge has been especially deficient, not only because certain manifestations are of relatively rare occurrence, but also because to a great degree our information on them has been builded mainly on museum observations, independent of, and uncorrelated with the clinical picture and progress of the lesion. The lesion itself, not being a cause of death, has rarely permitted observations at a stage corresponding to the active progress of the disorder. The advent of the roentgen ray as an aid to the early recognition and clinical study of the progress of these disturbances, we have felt seems to justify a further stimulus to exchanging observations. Just recently, in considering the allied subject of bone tumors, Morton, of Yale, has most forcibly, by example as well as precept, emphasized the importance of correlation of the various modes of study—the clinical examination and history, the roentgen ray findings, and the laboratory or microscopic observations. In general, the bulk of the literature on these dystrophies is recent, but in the older references the description of osteitis deformans by Paget, in 1877, still stands as complete as anything that has appeared subsequently, and the intensive study and conclusions of Von Recklinghausen, in 1891, while questioned for a long time, are now coming to be looked upon as essentially accurate. Of recent publication is a monograph on osteitis fibrosa by Dawson and Struthers, which, it would seem, can well be considered a masterpiece in the clinical, roentgenological, pathological and literary study of bone disturbances. The writers should not fail to acknowledge their own indebtedness to these authors in arriving at a clearer understanding of these dystrophies.

PRELIMINARY SURVEY

While there may be quite a number of disturbances in which there is seemingly a generalized involvement of the skeleton, of the pathological conditions which run an active course of whatever duration in life, all can be grouped under a few limited headings, and, we may be able to show,

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even classed in two basic subdivisions only, one a disturbance involving cytogenesis in osseus tissue (neoplastic) and the other the metabolic or chemical processes (metaplastic). We will not discuss that group of skeletal deformities which have an embryonic or prenatal origin, such as congenital achondroplasia. One of our cases does bring up for mention a skeletal disturbance known as multiple congenital exostoses. These appear early in life, and apparently are not true neoplasms but develop from aberrations of fetal growth, and, while frequently quite widespread through the skeleton, do not seem to be an essential finding in every bone, or to be associated with any disturbance in the osseous tissue of the bone from which they spring. More closely following our definition is that metabolic disturbance of children, rickets, which is likely to involve to some degree the entire skeleton, and does produce disturbances of form and architecture but not of cell type. The much discussed adolescent rickets has little in common except to show the disturbances of external form, and probably is not a pathological entity, but separable into one of the next two classifications—osteomalacia and osteitis fibrosa cystica, examples of which we are going to show. One other dystrophy will be considered, possibly most uncertain of all in etiology, Paget's disease or osteitis deformans. Gigantism or acromegaly is the last type of dystrophy to be mentioned, but can with difficulty be regarded as a primary bone disorder.

GENERAL DESCRIPTION

The three cases we have studied involve analysis of the following disorders of the above list: (1) Congenital multiple exostoses; (2) osteomalacia; (3) osteitis fibrosa cystica; (4) Paget's disease. In the first the roentgen ray appearance is familiar to all of you. Clinically the formations quickly reach a stationary stage and call for treatment only in so far as they provide mechanical difficulties. They are readily removed without fear of recurrence, and are unlikely to enlarge after adult life. In their histological structure they duplicate either compact bone or epiphyseal cartilage. They are rarely found, we believe, to be associated with contiguous changes in structure of underlying bone. With osteomalacia our knowledge is much less exact. A metabolic disturbance, usually occurring in early adult life, it affects diffusely the skeleton so that the bone loses calcium and becomes markedly rarefied. Under these conditions either fractures or bending deformities from static stresses are said to occur. Why bone should react thus in two so entirely opposite fashions to the same pathology is hard to explain. In one of our cases this particular disturbance appeared on top of an old rachitic deformity which supplied extremely forceful conditions for production of gradual bending; yet in fact the latter never occurred, while, instead, numerous spontaneous subperiosteal fractures were found in the long bones. Osteitis fibrosa cystica is common enough in isolated situations and often seems to be a cause of spontaneous fracture. It has been considered a benign form of tumor, but its appearance in practically every bone in the body, as in a case of ours, seems distinctly to raise the possibility that this process may be really a metaplasia. It probably has no definitely recognizable symptoms clinically in its early course; later rheumatic pains may occur. Usually its presence is first emphasized either by a deformity of enlargement or bending, or by a spontaneous fracture.

Finally we must consider Paget's disease, which is very well known clinically and roentgenologically. It has an age incidence, usually given as the fifth and sixth decades. Early subjective symptoms being rather indefinite, its origin may be much earlier. In the localized forms an enlargement or deformity of certain bones, as those of leg or face, may be the first indication. In the generalized form there is a more definite complex. The skull, especially the calvarium, enlarges, and a larger hat is necessary. The stature decreases.

In the spine the normal curves, especially the dorsal spine, are much increased and a stoop appears. There is a widening of the hips, coxa vara occurs with bowing of the thighs and an anterior curve is frequent in the tibia. Patients are often treated for rheumatism. The disease never seems to be a cause of death, and ultimately comes to a standstill. Fractures may occur in the affected bones, but these fractures rarely fail to unite after a little delay. Histologic material prior to death has rarely been observed. Opinion as to etiology seems still divided between chronic bone infection, a malacic disturbance, and a peculiar form of neoplasm. It has been thought to be a disease of the second half of life only. The authors have found, however, all the clinical, physical, and many of the roentgen findings of Paget's present in a young man, who, on microscopic study by biopsy, apparently shows the pathology of osteitis fibrosa cystica.

ROENTGEN-RAY FINDINGS

Osteitis Deformans

The characteristic findings are changes in the minute architecture of the bones, with alternating areas of porosity and bone production. One or other of these processes is usually predominant, with bowing and fractures present in the porotic type. In many cases the long bones are markedly bowed and show subperiosteal bone production, with roughened edges producing definite widening of the bones. Small cystic areas are sometimes seen, but rarely exceed 1 or 2 cm., according to Morton. The bones become much more radiopaque and often present a white chalky appearance. This is seen especially in the spine and pelvis and is frequently mistaken for the osteoplastic type of metastases, when the roentgen-ray examination is limited to these parts. The skull changes when typical are pathognomonic of this disease. There is marked thickening throughout the calvarium with irregular bone nodes scattered over this area, sometimes between the tables, and occasionally on the outer table where they may be palpated. The best description of this is by Baetjer, who compares it to the appearance of the curled, kinky hair of the negro, if calcified.

Osteitis Fibrosa Cystica

In this condition the bones are the seat of extensive fibro-cystic changes, frequently with marked deformity due to softening of the bones, often going on to pathological fractures.

The periosteum is smooth and is not involved in this process. The medullary cavity is usually much wider than normal and shows smaller or larger cystic areas. These are often multiple and are separated only by thin septa, sometimes presenting an appearance which might be compared to a collection of soap bubbles. The cortex is also involved by these and may be very much thinned or even broken through. It is often impossible to make out anything except the thin outline of the cysts where the cortex should be. If the cyst wall is broken through without being caused by a fracture of the bone, malignancy should be suspected.

The process tends to involve the diaphysis and rarely invades the epiphysis. In the femur the findings are often characteristic, showing marked bowing to the outer side with coxa vara, thereby greatly limiting abduction. This has been called by Von Recklinghausen the "Shepherd's Crook." There is usually thinning of the cortex on the convex side and thickening on the concave side. There is frequently a loss of lime salts, causing a general translucency. Long striæ of increased density with intervening small cyst-like areas are found replacing the usual normal trabeculation.

Osteomalacia

The striking appearance of this is osteoporosis of a rather peculiar type, showing striations paralleling the long axis of the bones. The bones are of little greater density than the surrounding soft tissues, making it difficult to obtain a satisfactory roent-

genogram. There are usually multiple fractures, which heal slowly and with little callus, and frequently show angulation at the point of fracture.

Fig. 1 (Case 1). Shows exostoses and changes in the shaft of the humerus such as existed in nearly every bone in the body.

Fig. 2 (Case 2). Shows osteoporosis and old subperiosteal fractures of both femora without any bowing or deformity of these bones.

CONGENITAL MULTIPLE EXOSTOSES

Case 1. G. D. (Case No. 27201). One reason for reporting this case, which is not so much a striking example of a not common though well known disorder, is because it offers a distinct contrast to the other cases reported. The skeletal dystrophy found in this case, although extremely diffuse, is apparently not metaplastic but distinctly neoplastic, or hyperplastic. Very little data in the way of history is available. The condition was an incidental observation during a routine physical examination. The X-ray negatives showed exostoses on practically every bone in the body. Apparently the deformities were giving no subjective symptoms and did not seem to produce any disability. The patient was conscious of abnormal bony prominences in many places, but could not remember any time when they were not present. He was certain that the growths were not enlarging. He was not very clear about the physical condition of his forbears, but had never heard that any condition like his own had occurred in any other member of his family.

We felt, in review, that some particular interest was attached to the quite marked dysplasia existing in the metaphysis of the bones as well as the growths attached to the surface.

Case 2. C. S. (Case No. 34412). This case is included partly from some indication of interest on its merits and partly in contrast to Case 3, for although we have here a generalized bone disturbance of rarefying type it can definitely be said to be outside the neoplastic group and probably is purely metaplastic and metabolic in origin. The patient was a man of twenty-eight with a family history negative for any factors bearing on his complaint, and

with a past history in which the occurrence of rickets in childhood and somewhat frail physical development were the only points of importance.

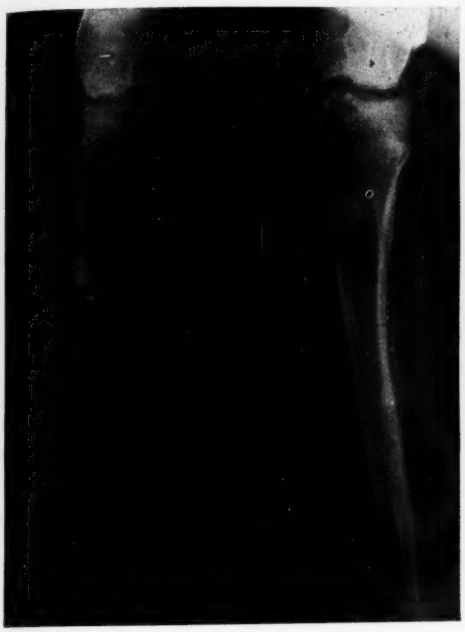

Fig. 3 (Case 2). Shows valgus deformity of knees, also old fractures of tibia of one leg and of fibula of the other, similar to the fractures seen in the femora. There were also similar fractures in the metatarsals of both feet.

He presented himself for treatment in the Department of Medicine in September, 1923, complaining of general weakness and of pain around the hips and left leg. It was also found that for seven or eight years he had complained of difficulty in walking, the legs feeling weak and stiff, and of twitching in the limbs at night, with occasional twinges of pain in the calves. Of late the element of pain had been decreasing, but weakness and fatigue increasing. When lying down he could get to a sitting position only after considerable effort with his arms, and when first getting on his feet his limbs would be unsteady and often give away. He would frequently fall on a slight misstep but never experienced any injury or disability save that after falling from a bicycle about five years before his hip had been sore for several weeks. On inquiry regarding the condition in the knees, found on physical examination, he stated this deformity had been present since early childhood and he had noted no changes.

Fig. 4 (Case 2). Shows fractures of the surgical necks of both femora, also of the superior and inferior rami of both pubic bones, with contraction of the pelvis. There is also osteoporosis of all the bones, making it difficult to obtain satisfactory roentgenograms.

Physical examination showed a short-statured, poorly nourished, pallid-appearing young man whose appearance suggested an age of fifteen to twenty rather than that of nearly thirty. There were definite rachitic deformities in the ribs, suspicious changes in the upper extremities, and a symmetrical marked valgus deformity of the knees, amounting to a deviation of twenty to twenty-five degrees. The only other notable finding on physical examination was an exaggeration of patella and ankle reflexes, greater on left. The condition was thought to be a neurological one, but detailed study failed to make out any definite complex. Soreness persisting around the hips lead to X-ray examination of the pelvis, which provided the clue to the underlying condition, and further X-rays showed a diffuse calcium absorption in all the bones and the presence of many

subperiosteal fractures. Very extensive laboratory studies were made over a period of several weeks. The blood Wassermann test was negative. The urine was consistently negative for Bence-Jones protein,

Fig. 5 (Case 3). Skull showing characteristic findings of Paget's disease. There is marked thickening throughout the calvarium, loss of normal bone detail, and replacement by areas of eburnation and porosity.

and showed no variation in the kind or quantity of urinary salts. Hyaline casts were frequently seen and albumin occasionally was present in small quantity. The specific gravity tended to be low. The phthalein excretion was a little subnormal, but concentration test satisfactory. The blood pressure was well within normal limits. There was a slight anemia without alteration of the color index. The blood calcium tended to be a little low (7 to 8 mgms.), with phosphorus in the plasma (between 5 and 6 mgms.). The basal metabolism rate was +15.

On a mild nephritic diet with addition of mineral-containing foods, and administration of calcium, phosphorus, and cod-liver oil, with attention to general hygiene, patient began to improve definitely in symptoms. When examined in May, 1924, he was feeling stronger than for a long time and looked very much better. X-ray examination did not indicate any very marked change in the skeletal picture.

In reviewing this case the most striking point was the presence of extreme bone softening with spontaneous subperiosteal fractures, without any deformity occurring, particularly in the femora, in spite of an

Fig. 6 (Case 3). Hands and forearms showing the same typical findings of Paget's disease as seen in the skull.

extremely strong predisposing factor in the shape of a bad static disturbance in the knees. The process was apparently entirely a metabolic one, and while there was a great deficiency in the chemical content of the bones, there was no process at work to alter the internal bone architecture.

Case 3. P. W. (Case No. 12695). A history of this patient in some detail may prove worth while, as it seems somewhat to suggest that a gradually progressing skeletal deformity of a generalized type, in an individual probably of neurasthenic make-up, may have produced vague and misleading complaints for some time before localizing ones developed.

He first came under our observation in December, 1923, but had a record in the Clinic going back to August, 1921, at which time he was under treatment on ac-

count of complaints of nausea with vomiting and urinary frequency. At that time he was thirty-five years of age, born and educated in Germany, but for many years a resident of Detroit, successfully engaged

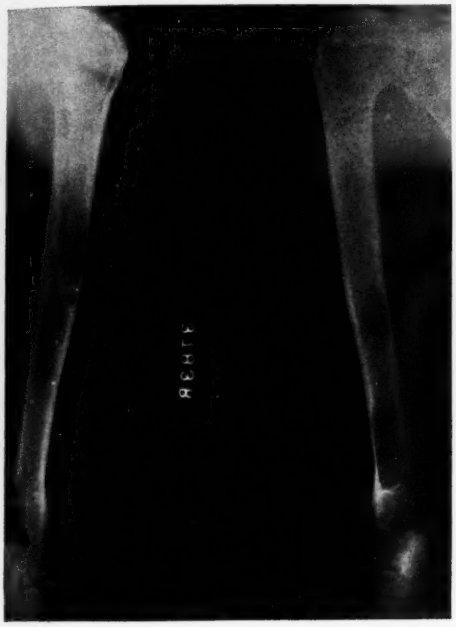

Fig. 7 (Case 3). Both humeri showing large cystic areas suggesting osteitis fibrosa cystica. These cysts were also seen in all the long bones throughout the body.

in the business of baking and ice cream manufacturing, which, however, he had recently given up "because he thought himself slipping." His father was a healthy, active man, meeting death in an accident at the age of fifty-two. His mother is living and, save for rheumatism, well at seventy-five. He himself was one of sixteen children, ten, however, dying either in infancy or early life, all before his own birth. The other five are still living and well. A strain of nervousness seems present in most of these, as well as in his mother. His own past history was not remarkable save for both luetic and neisserian infections in early manhood, with initial treatment for both, but later treatment for a stricture being necessary. He had been married for fifteen years, with three children living and well and no miscarriages occurring. His wife is living and well. The usual detailed medical history obtained at that time contains nothing in the past or present illnesses bearing on this

Fig. 8 (Case 3). Pelvis showing multiple cystic areas of both ilia similar to those seen in the long bones. The changes in the spine, portions of the pelvis, and upper femora suggest Paget's also.

subject. On very thorough physical examination the observers noted a small stature, feminine appearing face, and pallor, but no other suggestive or important findings.

For the next three years he was under observation and treatment along neuropsychiatrical lines and apparently a good deal was accomplished, for the mental attitude changed and the patient once more took up

Fig. 9 (Case 3). Pelvis showing defect of crest of right ilium where bone section was removed.

his old business with interest and success. However, during this period no diagnosis of any organic disturbance was arrived at. The laboratory studies were many and all, including blood Wassermann, showed normal findings. At this time, however, no phosphorus or calcium determinations were made. A year after first examination, observation of slight bow legs appears in the record, but apparently without symptoms. In October, 1922, his skull was radiographed, with special attention to sella turcica, which was considered normal, but no definite conclusions were noted as to other bone changes. About this time complaint of headaches became emphasized in the record, but refraction at that time showed an ametropia which was corrected with some relief. Also in the Fall of 1922 the record indicates complaint of aching in the limbs and back and increasing fatigue on any exertion. The basal metabolism at that time was found to be normal.

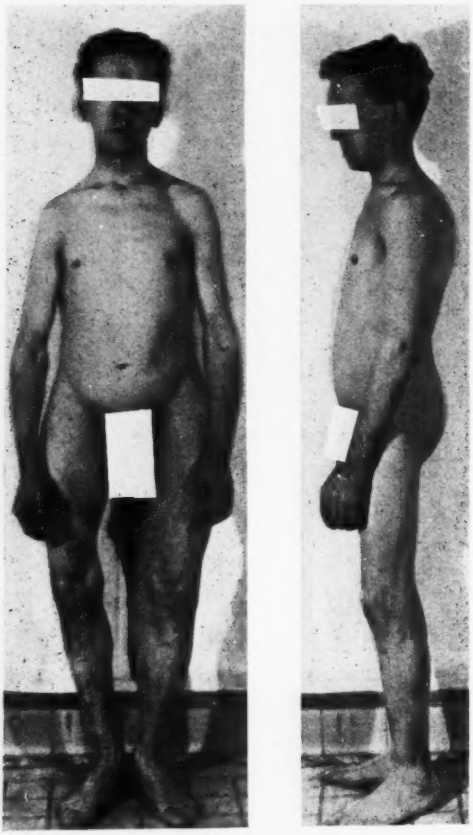

Fig. 10 (Case 3). This shows forehead and vertex of head large, exaggeration of normal spinal curves, bowing of limbs in varus, and marked anterior bowing of the right femur.

During 1923 the complaint of pain in the limbs, hips and back increased and mention is made of aching in the hips even while sitting, so that recumbency alone afforded relief. In December he was referred in consultation to the Division of Bone and Joint Surgery.

General physical examination at that time left the following main impressions: Although the facies suggested an age which might be between twenty and thirty, the addition of a mask over the face would bring at once the thought of an old man with Paget's disease; the head seemed large for the height, especially at the vertex and in the forehead; the physiological curves were distinctly exaggerated in the spine, especially the dorsal, and the ribs at the sides were overlapped by the iliac crests; the pelvis in width suggested the female, the hips were prominent and the limbs both above and below the knees noticeably bowed in varus. In addition, the right femur had a marked anterior bowing.

On further examination there was observed a considerable loss of mobility of the spine without any muscular protection. There was tenderness over the ischial tuberosities. The hip joints showed limitation of abduction (coxa vara) and on the right an abnormal external rotation which could not be overcome. Below the knees the legs did not seem remarkable, save for possible slight cortical thickening.

The impressions from this examination led to a line of questioning with interesting information additional to the history. As a boy he had been strong, active, well, and thought physically fit in the German secondary school training. He had always had a tendency towards bow legs, but photographs at different ages showed no deformity apparent with clothing on. About

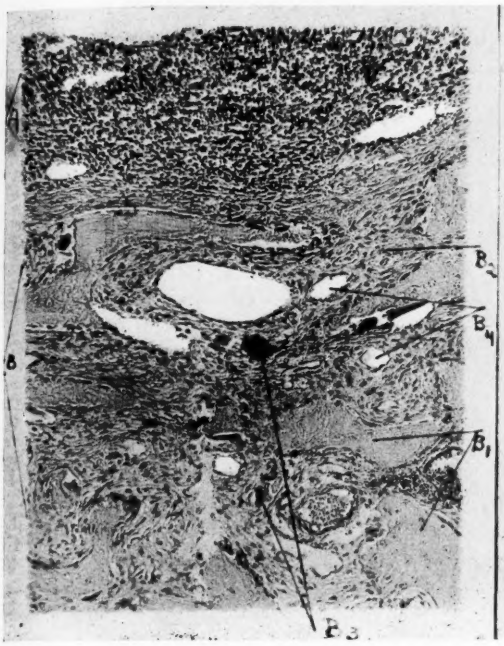

Fig. 11 (Case 3). Section taken from specimen removed from ilium. (*A*) Normal bone marrow. (*B*) Osteitis fibrosa. (*B 1*) Bone trabeculæ. (*B 2*) Fibrous tissue. (*B 3*) Giant cells. (*B 4*) Blood vessels.

Fig. 12 (Case 3). Section taken through cyst wall. (*A*) Cyst wall.

the age of twenty he began to notice that he tired more easily on standing than other people. He became greatly interested in Masonry about this time, but after about five years felt himself forced to drop out, purely because aching in his legs while standing during rituals became so severe that he feared he could not carry on. In the last five years the aching had spread to the hips and spine and lately has not been relieved by sitting down. Other significant facts were (1) that he has had to increase the size of his hat in recent years, (2) while a little taller than his wife when married, she is now taller than he. In this connection he was measured and found to be shorter by one and one-half inches than that recorded on the first examination in 1921. His weight had dropped about five pounds.

With this data at hand X-ray examination was turned to with great interest, for while the general appearance was that of Paget's the age was thought to be against this. The roentgenograms, which will be discussed later, indicated diffuse bone changes, with deformities, and with large cystic areas suggestive of osteitis fibrosa. However, the skull roentgenograms seemed absolutely typical of Paget's disease, and review of the skull plates taken two years previously indicated that the same characters could be made out.

The next study was directed toward blood chemistry. Complete analysis of inorganic elements established a definite phosphorus deficiency, with readings between 2.8 and 3.0 and calcium 9 mg. per 100 c.c.

The only treatment possible seemed to be along these lines. However, the patient was extremely co-operative and able to appreciate that attack on the problem was handicapped largely by inability to determine whether the process was a metabolic deficiency, a metaplasia, or a tumor of

bone. Accordingly on March 1, 1924, under local anesthesia supplemented for a few moments by ethylene, the right iliac crest from sacrum out was exposed and a segment of entire thickness of bone one and one-half inches square was removed. This section contained one of the large cysts, into which, during removal, the periosteal elevator broke as through an eggshell. There escaped a watery fluid, about the color of normal synovial. Nothing else seemed to be contained within the cyst. No complications followed the operation, the wound healing was *per primum* and with help of a sacro-iliac belt for psychic effect, the patient soon returned to work. On a high phosphorus and calcium diet and attention to general hygiene he has felt much stronger. The roentgenograms suggest that the operative defect has begun to fill in. The blood chemistry now shows a slight increase, since the original observation, of both phosphorus and calcium. Physical examination, however, suggests an increase in the amount of anterior bowing of the right femur. Pathological microscopic diagnosis: Osteitis fibrosa. Cultures made from the specimen produced no growth on several media.

In review, we would emphasize in this case the findings on physical examination, on skull X-ray and in the external morphology of the skeleton, which would anywhere pass as quite characteristic of the disease described by Paget and known also as osteitis deformans. Yet the latter is a disease of the second half of life, with no cases found reported that were definitely recognizable in the skeletal changes as osteitis deformans under the age of forty; while this patient, at present thirty-six, obviously appears to have had some of the symptoms of his disorder at the age of twenty-one. Also, both pathological diagnosis and radiographs of other bones can definitely be classified as osteitis fibrosa cystica. As the trend of pathological opinion is lately toward regarding both of these clinical entities as metaplastic processes with disturbances of cellular activity resulting from metabolic deficiency, there may present the following conclusions, namely, that we have in the condition described by Paget the end-result of a bone disorder beginning in early life and having at that time the pathological features which we have come to associate with the term osteitis fibrosa cystica (Von Recklinghausen), and in the past erroneously looked upon as a neoplasm of bone.

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PATHOLOGICAL FRACTURES [1]

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THIS paper is not presented with the purpose to discuss a new subject material. The general consideration of fractures to include the diagnosis, management and final results, probably concerns the medical profession as much as any one thing in medicine. Pathological fractures obviously are of equal interest. Alleged failure to diagnose fractures has in the past been the starting point of a large number of damage suits against physicians and surgeons.

"Since the organization of the medical defense of the Iowa State Medical Society there have been brought in Iowa against members of the Society one hundred seventy-five cases in the state and federal courts involving claims aggregating $1,774,000. These cases embrace one hundred fifty-nine different medical and surgical situations, of which one hundred twenty-four involve the practice of surgery, and out of the one hundred twenty-four surgical cases seventy-five, or slightly more than 60 per cent, are fracture cases in which claims aggregate $885,000. Not only are fracture cases relatively more numerous than all other cases, but they are relatively more dangerous, as shown by the fact that all judgments obtained against members of the Society have been based on negligence or unskillfulness in the diagnosis or treatment of fractures." [2]

The information with regard to the diagnosis and treatment of a spontaneous fracture to be obtained from the ordinary text-book on surgery is extremely brief and scanty. Codman mentioned in his article as secondary causes almost every human activity. And as stated, the secondary causes do not aid in diagnosis, prognosis, or treatment. The primary cause, or the pathological condition, is of prime interest.

Eisendrath's table of causes of pathological fracture (from Keen's Surgery, Vol. II, p. 83) is as follows:

1. Fractures resulting from bone fragility of local origin:
   - *(A)* Through tumors.
     - *a.* Primary and metastatic carcinoma.
     - *b.* Metastatic carcinoma.
     - *c.* Adenocarcinoma from the thyroid (osseous metastases).
     - *d.* Enchondroma and benign osseous cysts.
     - *e.* Echinococcus cysts.
   - *(B)* Inflammatory processes.
     - *a.* Pyogenic osteomyelitis.
     - *b.* Tuberculous osteomyelitis.
   - *(C)* Aneurysms.
2. Fractures resulting from bone fragility due to some general disease:
   - *(A)* Neuropathies.
     - *a.* Tabes dorsalis.
     - *b.* Syringomyelia.
     - *c.* Mental diseases (paresis).
   - *(B)* Senile changes.
   - *(C)* Exhausting chronic diseases.
   - *(D)* Atrophy due to non-use.
   - *(E)* Scurvy.
   - *(F)* Rachitis and osteomalacia.
3. Fractures resulting from idiopathic fragility of bone (osteoporosis, fragilitas ossium).

The incidence of spontaneous fracture (so called) is not a rarity. The clinical history and symptoms in this type of fracture are quite frequently misleading. The majority of the patients coming to, or having a pathological fracture occurring in, the hospital, do not suffer a great deal of pain. The trauma or the immediate cause of the fracture is often very slight or practically *nil.*

In the clinic of the University Hospital we have not had an unusual number of pathological fractures resulting from neoplasm. We have, however, had an exceptionally large number of fractures resulting from pyogenic osteomyelitis. In the department of oral surgery an unusually large number of interesting cases have been treated for pathological fractures of the

[1] Read before the Radiological Society of North America, at Chicago, June, 1924.
[2] Dutcher, C. M.: Relationship of Fractures to Malpractice Suits. *Jour. Iowa Med. Soc.*, Oct. 15, 1920, p. 331.

lower jaw. The etiology in the majority of these jaw cases has been pyogenic osteomyelitis. The osteomyelitis in the majority of the cases in the clinic has been of a low grade type of infectious organism, or at least an infection of long-drawn-out duration.

As stated by the oral surgeons, it may be well to emphasize the fact that the maxillæ have a great regenerative power when the treatment is correct. Most deformities resulting from necrosis are preventable when proper mechanical means are used at the proper time, and when surgery is limited.

We have had a number of fractures occurring in the hospital in which the condition was unrecognized immediately, in that clinical symptoms were not prominent. At the time of the fracture the pain was not increased, and the deformity very slight, if any. It behooves us, therefore, to make a very careful X-ray examination of each and every patient in which there is a bare possibility of a pathological fracture.

Another important feature in the handling of these cases is a detailed and very careful study with reference to the differential diagnosis as to the existing pathological lesion.

CASE HISTORY

A. S., aged seventeen, white, male. Entered the hospital November 20, 1923, with diagnosis of traumatic arthritis and malposition of a fracture of the femur. Family history, practically negative. Patient has had six fractures. Present illness began at birth with a fracture of the right femur. While learning to walk he tripped on a rug and fractured the right femur above the knee. Fracture healed in five weeks. One year later the left femur was fractured in the same manner. During the following year the right tibia was fractured. From the time he was three and one-half years of age until he was fifteen patient had no trouble. At the age of fifteen, as the result of a fall, he fractured the left elbow. September 23, 1923, he sustained a fracture of the left femur below the trochanter. The diagnosis in this case is osteopsathyrosis or fragilitas ossium.

FOUR-DAY BALANCE PERIOD

1. Mild creatin urea.
2. P. Ca. Magnesium retention, ratio of Ca., 2, P., 1, Mag., ½, relatively very high. Magnesium retention.
3. Nitrogen loss to sulphur loss 4.4:1. Normal ratio N:S change=10:1.
4. Blood findings CO_2 combining power. Van Slyke 63 (normal) pH-7.30. Beginning acidosis (Van Slyke Group VII).
   Calcium 9.4 milligrams % (normal 9–11).
   Phosphate 4.6 milligrams % (normal 2).
   3.9 milligrams %.
   Mag. 3.6 milligrams % (normal 2).
   Blood sugar 0.94 (normal or low).
   Urea nitrogen 14.7 (normal).
   Uric acid 3.5 (normal).
5. Blood sugar curve: from low starting point rapidly to high spike—abnormal.
6. Bone analysis shows high magnesium with little or no chondroitin sulphuric acid. (Analysis not yet completed.)

The following abstracts[3] of papers by A. Szenes are yielded by a search of the literature:

Spontaneous Fractures from Inadequate Food.—Szenes relates that twelve young people and three older ones with spontaneous fractures have recently been given treatment in Eiselsberg's service at Vienna. There was a history of rachitis in the family in five, and in the patient himself, in six. The femur was the seat of the fracture in five, the tibia in eight, including two cases with both. Pronounced osteoporosis was evident in all, and the inadequate food is evidently the explanation of this new clinical picture.

Calcium in the Blood.—While making the investigations recorded in the preceding abstract, Szenes determined the calcium content of the blood, finding it below the physiologic standard. This may possibly explain the delay in the coagulation of the blood noted in all these cases.

[3] *Jour. A. M. A.*, Oct. 15, 1921, p. 1294.

ADAMANTINE EPITHELIOMA [1]

By JOHN T. MURPHY, M.D., F.A.C.P., Toledo, Ohio

FOR nearly a century it has been known that certain cystic and other tumors of the maxillæ were of dental origin. Such tumors have been reported under various names, cystoma, cystic tumors of jaws, multilocular cysts, adamantine tumors, adamantinoma, etc.

Borst (7) suggested the name "adamantinoma" for these tumors, but the term "epithelioma adamantinum" is perhaps more accurate.

At the present time about one hundred cases are known in the literature. The condition is probably much more common than the statistics would indicate, as reports from large clinics include several cases observed within relatively short periods. Cystic tumors were at first believed to originate from dilated dental follicles. Some investigators later found epithelial elements in these tumors.

Broca (1) in 1869 published the results of his studies of maxillary tumors containing epithelium, to which he gave the name of "odontoma." He considered that the tumors originated from dental germs.

The dentine and cement are of mesenchymal origin; the enamel is of ectodermal origin. The epithelial elements in solid tumors of dental origin were, however, connected by some with the enamel organ.

Broca's "dental germ" theory was soon displaced by that of Malassez (2), who in a classical paper was the first to describe and illustrate the cell masses and to discuss their histogenesis. Surrounding the roots of normal teeth Malassez found masses of cells which he believed represented the remains of the dental ridge and some of the epithelial structures originating from it, especially the neck and the outer layer of the enamel organ. These cell masses he called "paradental epithelial debris." Malassez described numerous cell groups which he found scattered along the borders of the teeth from apex to crown. These are divisible into three groups: (1) superficial; (2) intermediate; (3) deep, the last being connected with the enamel organ. About the enamel organ he found groups of cells which showed transitions between cylindrical enameloblasts, round cells and stellate cells.

Malassez interpreted the cell groups as analogues of the very rich dental apparatus of some of the lower vertebrates which give rise to the supernumerary teeth of the so-called third dentition. They are derived from the invaginations of gingival epithelium which go to form the enamel organ.

According to Malassez, jaw tumors of dental origin are solid or cystic tumors arising from the paradental epithelial debris, located within the alveolar borders, excavating a cavity within the maxilla, distending the tissues until they become surrounded by a thin parchment-like capsule which crepitates on pressure. This may rupture and the disease extend to the antrum, etc.

Malassez's studies suggested the possibility that adamantine tumors may arise from the gingival epithelium and from any of the derivatives of the dental ridge. The cell masses described are distributed in the alveolodental ligament from the apices of the roots to the epithelium covering the gums. The "debris" may also be present in the narrow spaces of the jaw bones entirely outside the alveolodental ligament. Malassez's views have been generally accepted by later investigators.

Steensland, in 1905 (3), was one of the first in the United States to contribute an important paper on the subject of adamantine epithelioma, which he believes probably originates from structures described by Malassez as paradental epithelial debris. In the most carefully described cases

[1] Read before the Radiological Society of North America, at Chicago, June, 1924.

Steensland says that it is insisted that the tumors have no connection with the epithelium of the mucous membrane, although some authors believe in such an origin. He thinks that the growth of such tumors apparently takes place by the formation of new epithelial twigs from those already present. Some areas may be extremely suggestive of carcinoma. Structures closely resembling "epithelial pearls" have been described by some authors. But the adamantine epithelioma is relatively benign and Steensland found no instance in the reported cases in which metastasis occurred. Enlargement of the lymph nodes may result from associated inflammatory processes, especially infective.

In a chapter in a French text-book devoted to tumors of dental origin Ombrédanne (8) reviews the various theories as to their origin. He states that mixed tumors of dental origin may, in general, be divided into two groups: *adamantomes,* or soft tumors, and *odontomes,* or hard tumors. They usually occur where one tooth or several fail to erupt, and mostly develop in the region of the large molars in the lower jaw. All the principal or accessory elements which constitute the "dental germ" or "paradental epithelial debris" are, under certain influences, capable of undergoing an exaggerated and disordered proliferation, ending in the constitution of the tumors under consideration.

Broca's bulbar theory assigns the origin of dental epithelial tumors as mesodermic; Malassez considers them ectodermic. Ombrédanne thinks that Broca's theory, which refers the origin of odontomes to a true dental germ, is inexact and applies only to a minority of cases.

The majority of the tumors under consideration are of paradental origin. Thus, those adamantomes and odontomes which contain an included tooth are of paradental origin. All paradental tumors are mixed tumors which differ, from the histological viewpoint, only by the degree of evolution. All originate in epithelial proliferation.

Ombrédanne considers that tumors of dental origin may be solid (mixed tumors) or liquid (cysts). They are only slightly different anatomic forms, depending on an identical pathologic process. Adamantomes (soft tumors) and adamantine cysts are essentially constituted by the tissues of the enamel in the embryonic state; odontomes (solid tumors) and dentiferous cysts are those which contain dental tissue in the adult state.

Broders and MacCarty, in 1918, said that the number of theories advanced relative to this tumor naturally lead one to believe that little is known of the origin. It is usually located in the lower jaw at or near the angle, although a certain number are in the upper jaw. Microscopically the tumor has a connective-tissue stroma and columns of variously shaped masses of epithelial cells. In one instance the epithelial columns showed direct connection with the epithelium of the gum. This fact tends to suggest that this neoplasm arises from the regenerative or basal cells of the epithelium of the mucous membrane, which would be in accord with the histogenesis of all other types of epithelioma. The adamantinoma presents two distinct types of epithelial cells. The interior columnar cells, which are undoubtedly of the regenerative type, correspond to the columnar or regenerative cells of the enamel organ. These also correspond to the general cells of the epidermis, from which the enamel organ is derived. The polygonal-stellate cells which are so characteristic, represent an advanced stage of differentiation. They sometimes contain prickles which also have corresponding cells in the enamel organ and resemble the prickle-cells of the epidermis.

Steensland collected 21 cases (which he admits) from the literature. Of the 21 cases collected, the sex is stated in 18; 8 were in males and 10 in females. The age at which the tumor was first noticed was stated in sixteen cases; the youngest was eight years of age and the oldest fifty-eight

years. The greatest number of patients (five) were in the fourth decade.

The location of the tumor was mentioned in 20 cases; seventeen times it was situated in the lower jaw, twice in the upper; in one case both jaws were involved. The situation appears to be as frequent on one side as on the other. In the lower jaw the main mass of the tumor appears more frequently at the angle of the jaw. From here it may extend upward to the articular surface and into the coronoid process and ventrally as far as the median line. The two cases affecting the upper jaw were on the left side and in one case the sinus was invaded.

These tumors develop in the interior of the jaw bone, which may remain as a thin parchment-like covering. At operation they have varied in size from that of a plum to that of the head of a child, but are most frequently about the size of a hen's egg. In two cases the tumor was easily separable from the surrounding bone, which suggested that it was encapsulated. Most of the tumors described have been cystic. In four cases no macroscopical cysts were present, the tumors being solid. The cysts usually contain a clear, yellowish, slightly viscid or serous fluid in which cholesterin crystals may be present. The presence of a bony framework is mentioned in twelve cases.

The presence of parchment-like crepitation is mentioned by Steensland in five cases, but probably could have been demonstrated in more of the tumors which were surrounded by a thin shell of bone. Five of the twenty-one cases were infected tumors.

Steensland reported a personal case, in a female aged thirty years. The tumor was of two years' duration and situated on the left side of the mandible. The tumor was cystic, 7 cm. in diameter, and surrounded by a thin shell of bone with a bony framework. It was resected, and there was no recurrence after six months. Histologically, the tumor consisted of a connective-tissue stroma in which there were alveoli formed by epithelial cells. The epithelial elements represent the enamel organ, corresponding to the development of the stratum mucosum.

Kruse (4) has given a clear description of the microscopical appearance of these tumors, based on the examination of three cases representing different stages in the development of the enamel organ. In the first case the epithelial constituents consisted of dendritically branching twigs composed of epithelial cells and forming solid masses in a poorly vascularized stroma. The form and arrangement were similar to that of the dental ridge in an early stage of development. The second case had partly the same structure as the first, but there was more tendency toward the formation of a peripheral layer of cylindrical cells. In some instances small cysts were present. In the third case the tumor was conspicuously cystic. Some cysts were small, while the largest was the size of a hen's egg. The solid parts of this tumor were microscopically similar to the other two. The smaller cysts were lined with low cylindrical epithelium, the lumen containing granular hyaline material. The larger cysts were lined by a more or less cubical epithelium and three to four layers of squamous cells.

The tumors in this series correspond to different stages of development of the "anlage" of the tooth; each has certain individual characters, and, in addition, presents transitional stages to the others.

In the case reported by Chibret (5) there is a pronounced tendency toward the formation of the various tissues of the teeth. This case presents all the stages in the formation of the tooth up to the development of enamel and cemento-dental tissue.

Hildebrand's (6) case was in a boy nine years old who showed an excessive development of masses of teeth in the interior of the upper and lower jaw bones on both sides. Not only conglomerations of teeth, but also more or less completely isolated teeth were present. The eruption of the teeth appears to have been entirely irregu-

lar. In the soft tissues "anlagen" of teeth in all stages of development were represented, together with dentritically branching masses of epithelium.

Boidin and Delval (9) think that the study of adamantine epithelioma is of clinical importance because the condition calls only for an operation as conservative as possible. Clinically it masks a malignant neoplasm, yet some of the clinical, anatomical and eveoltive symptoms permit of arrival at a correct diagnosis.

These authors report two cases which illustrate two distinct types: (1) the deep or intra-maxillary type, and (2) the superficial or gingival type, which is much more rare. The first case, in a man of forty-one years, was easily diagnosed as cystic epithelioma. The right ascending maxillary branch was resected, which operation was followed by recurrence and re-operation. The second case was in a man of fifty-seven. The difficulty of differentiating adamantine epithelioma of this type arises from the fact that adamantine epithelioma, originating from superficial paradental epithelial debris, has but little tendency to become differentiated into adamantine cells.

Dean Lewis (10) reported three cases operated on for multilocular cysts, one of the lower and two of the upper jaw. He says that 70 cases of the kind have been reported in the literature. In these 70 cases the average time which elapsed between the beginning of symptoms and removal of the tumor was eight and one-half years. The oldest patient was seventy-five years of age. (Further particulars of the 70 cases are not given.) Lewis says that "small solid adamantinomas, precursors of multilocular cysts, may be mistaken for osteomas and cystic growths, for simple cysts of the jaw, or, if it is not known that

Fig. 1.

the growth has existed for some time, for soft central sarcoma." A roentgenogram should be an important diagnostic aid in these cases, as it should reveal the multilocular nature of the tumor early in its course. The smaller cysts are not, however, always shown.

A single unilocular cyst is usually a follicular cyst and multiple cavities are indicative of an adamantinoma. A roentgenogram should enable one to differentiate between the multilocular cysts and sarcoma. In a number of cases, however, it is impossible to make a positive diagnosis until the tumor is incised. Resection should be wide. It is practically impossible to enucleate. Inefficacy of conservative methods is demonstrated by the number of recurrences. Lewis says: "These three cysts, although they differ considerably in structure, belong to the same group, the cylindrical epithelium being their most characteristic feature, the polygonal and stellate epithelium aiding in their classification." He says, further, that large cysts can be reduced by aspiration of their contents before removal by resection. In one of the cases, the left upper maxilla was resected.

Wohl (11) adds four cases of multilocular cystic tumor of the jaw to the 70 cases mentioned as collected by Lewis and eight collected by New (13), making the total (up to 1916), 82 of this species of tumor.

Wohl thinks the usual nomenclature of cystic tumors of the jaw is unsatisfactory, and proposes the following: (1) inflammatory; (2) tooth germ, including *(a)* unilocular, *(b)* multilocular, *(c)* solid. These tooth germ tumors he terms "chorioblastoma." The chorioblastomatous cysts of the jaw originate from the embryonal rests of epithelial cord of enamel.

In 1906, Cignozzi (14) reported a case of multilocular cysto-adamantinoma of the lower jaw in a woman aged thirty-four years. He found 45 cases of this kind then in the literature. Of these, 22 were in women, 23 in men; one case in a child of two and a half years. Of 40 cases in which the age was stated:

8 were between 10 and 20 years;
14 were between 20 and 30 years;
9 were between 30 and 40 years;
5 were between 40 and 50 years;
the others up to 70 years old.

The solid type of adamantine tumor predominates in early age and is rare above the age of thirty. The cystic is more frequent in later age.

The statistics show that the development of these tumors is not in relation with the development of the teeth and is thus opposed to Broca's follicular theory and in harmony with that of aberrant "rests" of epithelial origin, although such rests may remain latent throughout life.

Solid tumors are not so slow in evolution as the cystic; the period of evolution in solid tumors oscillates between one and seven years, on the average about three years.

The semi-solid type evolve in from one to fifteen years. The pure cystic type mostly runs to ten to twenty years, *i.e.*, the unilocular cystic type ten years on an average; the multilocular, fourteen to fifteen years or more.

The tumors are essentially endomaxillary, in central part, *i.e.*, horizontal branch, especially on left side. They develop externally and downward, the alveolar margin being respected. Tumor is fluctuant; on depressing the anterior wall of the mucosa a parchment-like crepitation is heard which is pathognomonic of these cystic tumors of paradental origin, and which is never observed in sarcoma or carcinoma.

Cystic tumors may progress to an advanced stage without painful symptoms. In advanced stages, mastication, phonation, and respiration may be interfered with. The tumor may displace teeth and become ulcerated and fungous. In this stage crepitation is not easily heard and differentiation from sarcoma is difficult. A differential diagnosis point is that such patients do not

show disturbance of the general state, as the tumor is localized and the lymphatics not being involved, there is no cachexia.

In advanced cases, economic operations are almost always followed by recurrence.

Fig. 2.

Ample resection of the maxillary bone or mandible, and even disarticulation, may be demanded in some cases. No particle of tissue containing epithelium should be left behind. The semi-cystic and solid tumors require a more generous operation than do the purely cystic, and in these economic operations are more likely to be followed by recurrences.

Ferrero (15) also agrees with the origin of adamantine tumors of the jaw from the epithelium of the enamel and by degeneration of these elements. He reports a personal case of cystic adamantinoma of the lower jaw in a woman of forty-four years.

The cases of Frech, Monguido, Oberti, and Matsuoka are examples of solid tumors; those of Malassez, Kruse, Derujinsky, Bennecke, Nové-Josserand and Bérard, Chibret, Becker, etc., are examples of the cystic type. The latter are far more frequent than the solid type.

The slow evolution, absence of severe disturbances, pain or cachexia, the age (mostly twenty to thirty years), absence of glandular infiltration, presence of cysts, examination of cystic contents (which usually shows clear fluid rich in mucin and abundant cholesterin crystals), are all symptoms for differential diagnosis.

Ferrero did a hemi-resection of the right jaw in his case. He thinks less radical methods will not eradicate neoplastic germs.

In a similar case, Morestin (17) also did a hemi-resection, the patient being a woman of twenty-two years. There was no recurrence after three years. Morestin considered his case one of congenital origin.

The danger in these cases arises from local extension, as the tumor does not extend by the ganglions nor by generalization, nor does it cause any severe toxic alterations of the general state. Thus the tumor itself and a limited space in its vicinity must be totally extirpated. Thus treated, adamantine epithelioma is always cured.

An exact diagnosis gives the patient confidence, when the bad aspect of the tumor, its progressive extension, and often its enormous volume, suggest cancer.

Ewing (18) says that cystic adamantine tumors may attain a large size. He saw one the size of a child's head, which caused dysphagia and extreme exophthalmos.

The epithelial cells of adamantinoma exhibit all variations in form between stratified squamous epithelium and specialized adult enameloblasts.

The tumors have been observed from the sixth to the seventieth year of age. The duration of the process is usually prolonged and as high as thirty-eight years has been reported. The lower jaw is the chief seat of cystic tumors while solid growths occur more in the upper jaw. Deep-lying multilocular tumors may require the sacrifice of the whole maxilla in their extirpation. The

prognosis in the solid tumor is more unfavorable than in the cystic type.

Krompecher (19), in 1918, reported five cases of adamantinoma, solid and cystic. He thought that such tumors, besides originating from paradental debris or embryonal "rests," could also arise from the oral mucosa.

Graves (12) reported an adamantinoma in a negro boy of sixteen years, developing from adamantoblasts and showing "epithelial pearls," which was clinically diagnosed as sarcoma. This tumor was in the right superior maxillary. He says that odontomas are relatively frequent in negroes.

Carnathan's (20) case was in a woman of sixty-four years. In 1921 a tumor, diagnosed as spindle-cell sarcoma, had been removed from the right superior maxillary. In the following year a tumor, diagnosed as adamantinoma of epulis type, was removed from the left inferior maxillary. Re-examination of sections (from the first tumor) showed that there was no malignancy, although there were some spindle-cells.

In Muller's case (21), examination by X-rays resulted in a definite diagnosis of adamantine epithelioma. On operation, multilocular cysts were found. Pathological examination showed cysts lined with stratified squamous epithelium and packed with cells of the same type. These occurred in a loose fibrocellular connective tissue of indeterminate character. They may well represent epithelial penetration in the deep gum tissue with secondary cyst development in the penetrating epithelial roots.

Slow growth, absence of teeth over the part involved, and the X-ray appearance of the multilocular cysts are the important diagnostic points. Extirpated with gouge, there was no recurrence in the case cited.

Winter (22) and Schlosser (23) in some recent reviews of the subject have collected cases in the literature, but no new points were brought out in these papers.

Wohl (11) says: "The points of diagnostic importance are the clinical history of the case, and the extremely slow and symptomless growth which differentiates these tumors from sarcoma, endothelioma and myeloid tumor. The second point in the history is absence of teeth over the area involved, and the third point is the absence of infiltration and fixation to the bone of the jaw. The X-ray is of some diagnostic value. Microscopic sections show cells of the adult type corresponding to the cells forming enamel and dentin; arrangement is in long strings and gland-like structures, the latter sometimes presenting dentin formation in the lumen of the gland-like masses. Intact basement membrane is always found, sharply demarcated by cell masses and gland-like structures from surrounding connective tissue. There always occurs somewhere in these masses some of the characteristic stellate cells. The great variation of cells found in adamantine tumors will differentiate them from endothelioma, in which the cells are of uniform shape and type."

The method of treatment is a radical, wide excision, using either actual or the electric cautery, with complete removal of all epithelial tissue.

The following is the history of the case the writer wishes to report:

CASE HISTORY

C. L., age 57, laborer.

Chief complaint: Painless tumor of left side of face.

Present illness: Six or seven years ago was struck by a small piece of iron on the side of the nose, but this healed without any trouble. About one year ago he noticed a small swelling at the site of this injury. This continued to enlarge painlessly and about three months ago it occluded the left eye.

Past illnesses: Childhood diseases. Typhoid fever seventeen years ago.

Family history: Father died at seventy-two, cause unknown. Patient thinks his mother died of tumor, age unknown.

Physical examination: (Eyes) Left closed by tumor. Right reacts normally to

light and accommodation. (Ears) Canal normal. Membranes normal. (Nose) Left side included in growth. Right side, no enlarged turbinates. (Teeth) Many old roots. (Tonsils) Not enlarged.

Large rounded tumor on left side of face extending from level of zygoma to upper lip as far as mid-line in front and over to the right side of nose. Tumor is of a dark color, fluctuates freely, and is adherent firmly to deep structures.

(Chest) Contour and expansion fair. *Lungs*—no pathology on percussion or auscultation. *Heart*—not enlarged. No murmurs.

(Abdomen) No scars of operation. No tender areas or masses.

Nervous system: Right patellar reflex absent. Left patellar reflex exaggerated. Scars on both shins.

Blood pressure: Systolic 130, diastolic 95.

Arteries rather hard and tortuous.

X-ray report shows tumor mass extending outward from the region of the maxilla. This mass shows evidence of generalized new bone formation throughout. The calcification is suggestive of a calcifying chondroma.

The operation was performed by Dr. Douglass and myself, using electric coagulation knife for everything but the skin incision. The excised tumor involved all bones of left side of face, including floor of orbit, hard palate, malar bone and superior maxillary. Conserved orifice of mouth and some mucous membrane. After resection and coagulation, were able to close mucous membrane of mouth, excluding that from nasal cavity. This cavity was packed with gauze and wound was left open. Mucous membrane of mouth was closed with int. chr. catgut and horse hair, and skin with dermal.

The pathological report by Dr. Joseph Colt Bloodgood, of Baltimore, Maryland, is as follows:

"Diagnosis: Jaw—adamantine epithelioma.

"The gross appearance of this tumor is very characteristic. It looks like polycys-

Fig. 3.

tic osteitis fibrosa. The cystic adamantine epithelioma also has this appearance.

"With the microscope we see that each cyst is lined by epithelium and if one were not familiar with the adamantine epithelioma it might be called a carcinoma spinocellulare. In fact, this belongs to the group of adamantine carcinoma or epithelioma, which are hard to differentiate from carcinoma. But I believe this is an adamantine tumor. It does not metastasize, and if completely removed it remains well. It easily implants, like myxoma or chondroma."

This patient was operated upon Dec. 11, 1923, and up to the present time has shown no evidence of recurrence.

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DISCUSSION

DR. JOSEPH COLT BLOODGOOD (Baltimore, Md.): Dr. Murphy's specimen is of an unusual type—polycystic with the cysts rather minute, and was situated in the upper jaw.

I find there are recorded in the Laboratory of the Surgical Department of Johns Hopkins Hospital thirty cases since 1889. Of these, including Dr. Murphy's case, six involved the upper jaw and twenty-four the lower jaw.

Adamantine carcinoma resembles the glioma of the brain. Both are classed as malignant tumors, but neither produces metastasis. The glioma is always fatal, because before recognition it has infiltrated beyond operative removal. On the other hand, the adamantine tumor originating from the enamel organ buried in the jaw is confined within a bone shell. Experience teaches us that when the tumor is within the bone shell, when operated upon, and there has been no previous operation to disseminate it outside the bone shell, complete resection has accomplished a cure without an exception. For example, in 1894, Dr. Halsted excised the entire lower jaw for a tumor of twenty-nine years' duration, and the patient died of other causes eleven years later.

The operative treatment of the huge tumor which involves the upper or lower jaw is then well established—complete excision, and this can be done under local anesthesia. This operation is mutilating and, except in the hands of an experienced surgeon, dangerous. To-day the majority of people seek advice when the tumor is a small swelling, and its removal can and should be accomplished without mutilation. (I have recently discussed this in the *New York Medical Journal*, March 21, 1924.)

Pathology. The polycystic type is most common, but as a rule the cysts are larger than in the case reported by Murphy. The absolutely solid type is rare, more common in the upper jaw, and the fine polycystic type of Murphy's case is also more frequent in the upper jaw.

The tumors arising from the enamel organ, for practical purposes, can be divided into two groups: (1) the dentigerous cyst, which resembles the dermoid cyst in benignancy, and in its epithelial lining; (2) the adamantine carcinoma, solid, cystic, or polycystic, resembling the carcinoma in the dermoid, except that it does not produce metastasis. The contents of the dentigerous cyst, however, is entirely different from that of the dermoid cyst—a clear or cloudy fluid, rather than the granular material of epithelial debris.

Diagnosis. Up to the present time I have been unable to find distinguishing clinical or X-ray differences in the various pathological conditions which may arise in the region of the displaced enamel organ and produce a swelling within the confines of a bone shell in the upper or lower jaw. When the tumor can be completely excised without exposing it, diagnosis is not necessary. But this rarely occurs in the jaw, if one wishes to cure without mutilation. One, therefore, must open the bone shell. This can be done best under local anesthesia. If it is a dentigerous cyst, one exposes at once a connective-tissue membrane which can be easily stripped from the bone shell, and when opened, exposes a cavity containing clear or cloudy fluid. The adamantine carcinoma looks entirely different. Beneath the bone shell there is not a connective-tissue lining, but a firm, opaque-white tissue filled with minute cysts, but more characteristic areas of fine granular material like an ordinary carcinoma. There may be larger cysts with a smooth lining not unlike that in the dentigerous cyst. But malignant tumor tissue is always found somewhere. It is very important to distinguish between the benign and malignant, because my experience with eight recurrent cases demonstrates that, with but one exception, all have died, due to repeated recurrences and final involvement of the brain, or death from septicemia. Therefore, if the tissue exposed suggests the ada-

mantine carcinoma, the tumor should be immediately destroyed with the electric cautery or the red-hot soldering iron. I have gone into the details of this diagnosis and cautery treatment in the article referred to above.

It is interesting to note that Murphy, in his operation, used electric coagulation. At the present time there is a great deal in the literature about electric coagulation, diathermy and endothermy. My experience has been chiefly with the cautery—first, the Paquelin cautery, then the electric and Percy cautery, and now the red-hot soldering irons of all sizes and shapes. I have used the latter on small and large tumors and find them applicable to the small as well as the large, and it is hard to conceive that any type of cautery can compete with the red-hot soldering iron when one is attacking a very large neoplasm. It also has the advantage of economy and simplicity.

Now that the educated public is more frequently coming under observation with a small swelling in the region of the upper jaw, and now that the X-rays reveal exactly the site and extent of the normal tissue destruction, it is very important for the operator to keep pace with and be prepared for the more difficult differential diagnosis when he exposes the disease, and the more technical operative treatment which apparently in all the malignant types must include some form of thermal cauterization.

Pre-operative X-ray Treatment. A recent observation has shown the value of this. There was a definite swelling of the body of the left lower jaw almost the size of the index finger, easily seen and palpated on the outer side of the jaw. The X-ray showed a light shadow about the incisor, canine and bicuspid. The teeth were a little loose, and there was not much pain. The roentgenogram, on the whole, resembled a root abscess with osteomyelitis, or a slightly infected dentigerous cyst. However, in view of a possible giant-cell tumor, X-ray treatment was given. The palpable and visible swelling has entirely disappeared, in the roentgenogram the light area has almost been replaced by new bone, the teeth are no longer loose, and practically all painful sensations have gone.

I have exposed three examples of the adamantine carcinoma to very extensive radiation before operation, one to radium, and two to heavy X-rays. In two of them I knew it was the adamantine tumor, because they had been previously operated on and the sections had been preserved. There was no evidence of destructive effect from the radiations, and the tumor tissue was later removed.

Bone sarcoma.—Surgery seems to be the method of choice in the treatment of bone sarcoma, and thus far comparatively few cases have been reported in which roentgen-ray treatment alone was used. It seems desirable that roentgenologists should be given an opportunity to treat more of these unfortunate cases.

Whatever dose may be best, a definite plan of intensive treatment pushed to skin tolerance should be adopted, whether using large or small portals of entry, including also the entire drainage area in succeeding doses to and including the chest. Applying treatment to the bone growth is not sufficient; there should be gradual overlapping of areas every few days until nearly the entire body on the affected side is covered, then a definite period should elapse before the dose is repeated.

J. D. CAMP, M.D.

Roentgen-ray Treatment of Bone Sarcoma. M. B. Palmer. Am. Jour. Roentgenol. and Rad. Ther., June, 1924, p. 550.

BONE FINDINGS IN CHLOROMA [1]

By ROBERT G. ALLISON, M.D., MINNEAPOLIS, MINNESOTA

CHLOROMA is a disease of unknown etiology which is manifested by the occurrence of greenish tumors of the bony and lymphatic systems and various internal organs. Ewing says the process belongs with the systemic sarcomas of blood-forming organs, effecting primarily either the lymphatic system proper or the bone-marrow.

Although numerous cases have been reported, we have been able to find only two cases with X-ray examinations recorded. These two are reported by Gould and Le Wald in the *Archives of Pediatrics,* June, 1916.

It is beyond the scope of this paper to enter into a detailed description of the clinical and laboratory findings of chloroma. Our object in reporting this case of chloroma is to present the X-ray findings and compare them with the X-ray findings in the cases of Gould and LeWald.

The patient, L. C., female, age three years, was admitted to the University Hospital on January 26, 1924. A brief summary of the history revealed the following facts:

Present Complaint: Painful joints, headache, and swelling of the eyes.

Present Illness: During August, 1923, the patient developed a painful swelling of the ankles, knees and wrists. The swelling remained constant, although the pain would abate occasionally for a few days.

In October a tumor mass appeared on the outer border of the right eye. The eyelid became swollen and gradually the right eye became almost closed. One week before admission a similar condition developed in the left eye. A few days later multiple rounded areas of swelling appeared over the entire cranium.

Past History: Patient has had no illnesses except lobar pneumonia in December, 1923. The recovery from the pneumonia was prompt and uneventful.

Family History: Family history is entirely negative.

Operations: Tonsils were removed three weeks before admission to the hospital, in the hope that her rheumatism might be improved.

One week later her physician attempted unsuccessfully to aspirate the swelling of the outer border of the right eye.

Physical Examination: Patient is well-developed and well-nourished female child of three years of age.

Head: Cranium is normal in size and shape. Multiple, nodular areas varying in size from that of a pea to that of an olive are present in the occipital and parietal areas. One is freely movable with the scalp, the others are fixed.

Eyes: There is a bilateral swelling of the eyelids, with a bluish discoloration. The right eye is completely closed. The lids of the left eye are nearly approximated. There are hard, nodular swellings extending from the outer angles of both eyes toward the ears.

Ears, nose, mouth, neck, chest and abdomen are negative.

Lymph Glands: The posterior cervical glands are enlarged, pea-size and hard.

The extremities, joints, and bones are negative, except that both ankles are painful. Pain is increased by manipulation. No redness or swelling is present.

Laboratory Findings: The blood Wassermann is negative. The blood Wassermann of both parents is negative. Blood culture is negative. Von Pirquet is negative. Urine is negative. Bence-Jones bodies are not present.

Blood Examination: Hemoglobin, 81 per cent. Red blood cells, 3,416,000. Leucocytes, 184,000.

[1] Read before the Radiological Society of North America, Chicago, June, 1924.

Differential Count: Polymorphonuclear, 8 per cent. Lymphocytes, 15 per cent. Large mononuclear, 2 per cent. Eosinophile, 1 per cent. Myeloblasts, 74 per cent.

X-ray Examination: Plates of the nasal accessory sinuses were unsatisfactory. Examination under anesthesia was refused.

Stereoscopic plates were made of the skull. The only bone change which could be detected was a slight separation of the coronal suture.

Plates were obtained of both wrists, both ankles and both knees in the antero-posterior and lateral directions. The joints and epiphyses showed no abnormality. We could detect no involvement of the cortex or medulla of any of the bones. There was a fairly marked and extensive proliferative periostitis involving the shafts of the long bones. Most of the new bone was laid down parallel to the shaft. Near the epiphyseal ends, however, there was considerable new bone laid down at right angles to the shaft.

I was unable to make a diagnosis from the plates. The lesions presented roentgen characteristics of both hereditary syphilis and periosteal sarcoma. Sarcoma was, of course, ruled out by the wide distribution of the lesion. Syphilis seemed unlikely owing to the fact that some of the new bone was laid down at right angles to the shaft.

The clinical and laboratory findings permitted a definite diagnosis of chloroma. The patient left the hospital five days after admission and could not be followed.

DISCUSSION

DR. L. T. LEWALD (New York): I have the original slides of my two chloroma cases and it will take but a moment to show them, and each of us can then compare these cases with Dr. Allison's case. I think it is dangerous to lay down the dictum that deposits of bone at right angles to the shaft are characteristic of a particular lesion. Dr. Meyerding[1] has emphasized it. In a case of secondary bone tumor I have seen this same laying down of the bone at right angles. In that case it was a secondary metastasis in the skull in a primary thyroid tumor. Likewise, one cannot say that the laying down of bone at right angles always means sarcoma, for in the case of chloroma, Dr. Allison has shown there is some

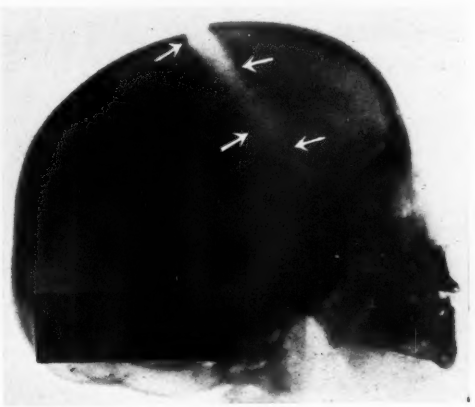

Fig. 1. Dr. Le Wald's first case of chloroma. Female, aged three and one-half years. Note extreme separation of coronal suture.

tendency to radiation at right angles to the bone, while I think you will see in my cases of chloroma it is mostly parallel to the bone. It is probably the same reaction expressed in a little different way, and we must be cautious in drawing a conclusion in that respect. There is, as Dr. Allison says, a more marked separation of the suture lines of the skull in my cases of chloroma than in his (Fig. 1). In each case a section taken from one of the enlarged glands in the cervical region showed the typical appearance of chloroma. In a third case, the films of which I saw in consultation with Dr. John M. Wheeler, the roentgenologist who first saw the case is said to have made a diagnosis of traumatic separation of the suture lines which led to a diagnosis of fracture of the skull.

In the second case you see again that the separation of the suture lines is absolutely characteristic. I call attention to the humerus, where there is laying down of bone

[1]Dr. Meyerding's paper on "Roentgenographic Types of Sarcoma of the Long Bones" was received too late for publication in this issue. It will appear in the next (December) issue.—Editor.

about the periosteum, and also a peculiar involvement of the medulla with rarefaction. I thought this combination of the change in the medulla, plus the change throughout the cortex and the periosteum, was characteristic of chloroma. In the

Fig. 2. Dr. Le Wald's second case of chloroma. Male, aged five years. Note production of new bone *parallel* to the shaft. Note also changes in the medulla.

next slide (Fig. 2), notice that about the femur there is a production of new bone in the region of the periosteum which is distinctly *parallel* to the shaft of the bone, with considerable change in the medulla. I think that Dr. Allison's contribution is very valuable in showing that in chloroma one may have production of new bone at right angles rather than parallel.

I would like to say a word in regard to the very interesting cases presented by Dr. Doub and Dr. Peabody relative to Paget's disease. I have studied some thirty cases of Paget's disease and I think that in those thirty cases there were three that showed marked cystic degeneration or cystic changes. Now my impression is that we had better consider this as a cystic degeneration complicating Paget's disease rather than confuse it with osteitis fibrosa cystica, which is a different condition. Paget reported several cases of what he considered sarcomatous degeneration. I am inclined to believe some of these were cystic. Three of our cases, clinically regarded as sarcoma, were operated on, and the material scraped out proved to be non-malignant. It is my impression in regard to the appearance presented in the case shown to-day that it is one of Paget's disease which shows unusual cystic degeneration in places.

Dr. Clarence F. Ball (Rutland, Vermont): I have two cases I would like to report. The first is a man fifty-five years old, who was injured about the shoulder in a marble shop a year ago. After a few months the shoulder became lame and it was considered as a case of osteomyelitis, both clinically and on X-ray examination. Operation was advised and refused. Patient remained in the hospital about three months under general care, following which another X-ray examination showed that there had been almost a complete decalcification of the head of the humerus, with a spontaneous fracture below. Operation was again advised and the resection was performed a few days later. Microscopical examination showed the tumor to be that of the so-called Ewing's disease, or angio-endothelioma. Ewing himself, when studying the roentgenogram, recently made a diagnosis of a giant-cell sarcoma. After study of the microscopical section, however, he stated that it was impossible to find any evidence of giant-cell formation, thus classifying it as a true angio-endothelioma. Radiologically, then, it becomes necessary when viewing conditions appearing as a giant-cell sarcoma, to consider the possibility of the lesion being that of Ewing's disease. X-ray examination of the gross specimen brings out a sharp difference as

to the amount and arrangement of the lime salt absorption. In the giant-cell tumor there is more or less of the worm-eaten appearance, while in this condition there is almost a total absence of any calcification.

The second case is that of a boy who was slapped on the head by one of his school mates, last September, while on his way home from school. There is now a large protuberance on the top of the head, measuring twenty-nine inches around the chin and over the vault of the tumor. At first he was treated for more than three months for syphilis, though the boy's Wassermann blood tests were all negative. He received this treatment because of the distinct family history of this specific infection. Later he was sent to Boston for examination, at which time a piece of tissue was removed and a diagnosis of osteogenic sarcoma was made. X-ray examination shows extent of lime absorption together with multiple areas of metastases scattered throughout various portions of the skull. The patient was later referred to me for X-ray treatments in the hope that something might be done to stay the progress of the disease. For ten days after bringing him from Boston, he was not expected to live. After recovering a little from a series of convulsions, he was brought to the office in a semi-comatose condition. He was given an anterior-posterior treatment. A few days later he came in for his second treatment and seemed somewhat brighter in appearance, taking more interest in the treatment, etc. At the time of the third treatment he was very much brighter and asked to walk. At the time of the fourth treatment he walked in, and said he had been walking for a day or so before. His general condition was very much improved and mentally he seemed almost as alert as would be expected of a boy of his age.

Additional Data: Since making this report the patient has again had a series of convulsions, following which he has been given another course of treatments with less satisfactory results than previously. There are now evidences of a definite right-sided paralysis.

Dr. B. C. Darling (New York): The procedure of the X-ray examination of bones is comparatively recent in medicine, and directly after the stage of finding out what we think we do know must come the realization of what we do not know. I feel like saying, after Dr. LeWald's encouragement, that the sooner we stop trying to make a pathological diagnosis from X-ray films of bone diseases, the more rapidly we will advance along sure lines. Baetjer says, and Lovett shows, that it is a matter of the active agent against the character of the material involved. I am much impressed with the importance of Dr. Meyerding's paper. I want to ask him some questions, together with giving my own reaction. The first is, Can you differentiate between the medullary and cortical tumors, the benign from the malignant? I would like to know if Dr. Meyerding thinks he can and how he does it. He brings up a very important point, and I would like to have him make it as definite as he will. Does he believe that the trauma directly causes the sarcoma, and if so, how? Now that is a large contract and he does not need to go into it at length, but it is very important. I have been through two or three cases before the Compensation Commission in New York, where Dr. Coley claimed that sarcoma was caused in nine days and amputation was performed in three weeks and metastases were found which must have been there before the amputation.

That brings me around to the treatment. Another point I want to ask is this, Do they believe in biopsy in the Mayo Clinic? The next point is the treatment: What good is amputation in these cases, I would like to know? A man lives a couple of years—the longest case that lived was four years, as I understood it. Although he did not have an amputation, he did have an operation. Now Ewing says, and I am pretty clear that I have it right, that you are not to do a biopsy and not to operate and not

to amputate in these cases. The only thing you can do is to put your hope in the X-ray and radium treatment, so that it does throw a great deal of onus on the roentgenogram. It would be fine if we could tell which cases were benign and could be scraped out and have bone graft put in, and which were malignant and would better be let alone. I would like to know, also, whether they are curing many of these with radium, there. They are not curing very many in the East, in spite of a lot of talk we are hearing and some newspaper accounts. Coley's serum—are they using that out there, and is it any good? Nobody thinks it is, in the East. I would like to ask Dr. Meyerding to particularly study the matter and tell us at some time more about the duration of these, whether they are caused by injury, and whether one can estimate the duration. In the one particular case I mentioned we had a sclerosing medullary tumor that Coley said came on in nine days, and some of the rest of us thought it must have been there several months, so that point made considerable difference.

Dr. W. L. Ross (Omaha): I should like to speak on the practical side of Dr. Bundy Allen's paper, inasmuch as he points out the number of lawsuits that are pending and have been brought in Iowa for malpractice in fractures, and I would like to ask if he knows the percentage of those lawsuits in which an X-ray examination had been taken within 24 or 48 hours after the sustained accident. I also want to mention the fact that since the war, the orthopedic surgeons are insisting on the reduction of the fracture immediately, and those of us who were taught that we always had ten days in which to set a fracture are likely to have trouble in the way of litigation if we stick to that rule. So I believe that, since that is one of the things now being required, and a newer thing, we should all insist upon the X-ray examination being made as soon after the fracture is sustained as possible, thus throwing the weight or burden upon the patient. I believe we should insist upon the X-ray being taken, so that a definite record can be made of the invalid and a course of treatment outlined.

Dr. Allen (closing): If I understood the question asked, it was about the number of cases that had been irradiated immediately after the fracture. In practically all the cases, the malpractice suits were brought because of negligence in the diagnosis and management of the cases, but I cannot give the percentage.

Dr. Peabody (closing): In trying to cover a great deal of material in a short time it was necessary to sort of hit the high spots, but in the second case I did want to emphasize that the most peculiar thing to us lay in the deviation in the alignment of the lower extremities, the valgus deformity in each leg being about 25 degrees, with an angle between the two legs from the knee down of 45 degrees. With his knees together, the patient's feet would be 24 inches apart. He showed extremely rarefied bones, hardly radiable with satisfaction and indicating incomplete spontaneous fractures; but still the line of the shaft of these bones remained absolutely solid. In a rickety child who shows these deformities we have been accustomed to consider them the result of static stresses acting on the pathologically softening bone. In spite of most severe preexisting deformity the static stresses have not resulted in any curving of the rarefied bone. In the third case which we are finding so difficult in locating in diagnosis, Dr. LeWald made this point, that cystic degeneration has been frequently found in Paget's disease, and I am inclined to think that this case does represent an unusually early example of Paget's disease. For instance, you recall the upper half of his pelvis in which the wing of each ilium was almost entirely cystic. There was hardly any normal bone to be seen and this part of the pelvis was entirely free from the sclerotic changes characteristic of Paget's disease, that is, any new bone formation.

We might also show slides of humerus which showed striking changes in the lower part of the diaphysis on both sides. On both sides very large cysts were present of almost the diameter of the bone, and here again in neither of these two long bones was the opposite type of pathogenic change noted. We were perfectly frank with this man; we told him we could not make a diagnosis, that we could not even treat him with any surety that we would be able to do anything for him. He proved co-operative in every way. A considerable section of the bone was removed and Dr. Hartmann went over sections of it with great care, made a large number of them, and was unable to find in any of those sections any of the bone changes which he considered indicated Paget's disease, but thought them to be entirely characteristic of osteitis fibrosis.

Keloids.—Keloids occur only in certain individuals and it is generally recognized that negroes are particularly prone to this malady. Any method of treatment that produces a wound is usually followed by a keloid larger than the one removed. Irradiation is not a true prophylactic against the development of keloids, but is of distinct value if employed at the proper time.

Very large keloids cannot be removed by either the roentgen ray or radium without the risk of serious sequelæ. In such instances the growths should be surgically removed and irradiation employed as a prophylactic, for it is generally recognized that an early lesion can nearly always be successfully treated. Very thick or very hard lesions may be so resistant that irradiation is unsafe. In the case of small lesions the skin is usually soft and pliable, but telangiectasia is prone to occur.

The author reports sixteen patients, with a total of thirty-five lesions. In four instances telangiectases developed; in fifteen instances no telangiectases had developed at the end of one year, and the result in sixteen instances was unknown. The large keloids in all instances showed telangiectasia.

The technic employed in the case of small lesions was as follows: spark gap, 7½ in.; milliamperage, 5; time, 1 min. and 15 sec. to 1 min. and 40 sec., focal skin distance, 9 in.; no filtration, treatments at intervals of three weeks. When the lesions were large, from 1 to 2 mm. of aluminum was employed and the time proportionally increased. When the lesions were on the face, care was used not to produce an erythema, which probably accounted for two failures where there were small, diffuse bands. It was observed that soft keloids will frequently disappear gradually over a period of months following two or three treatments. In the latter cases advantage was taken of that fact and the following technic used: Two treatments were given at intervals of three or four weeks and the patient allowed to rest for three or four months, when two more treatments were given if necessary.

The author believes that the vast majority of keloids can be successfully treated by the roentgen ray. The chief risk is that telangiectasia may develop. Small, hard lesions, and lesions occurring upon the face are extremely hard to handle. Large lesions should probably be excised and irradiation begun immediately after the operation. Keloids in negroes are more difficult to treat than those in white persons.

J. D. CAMP, M.D.

The Roentgen-ray Treatment of Keloids. H. H. Hazen. Am. Jour. Roentgenol. and Rad. Ther., June, 1924, p. 547.

DEEP THERAPY SIMPLIFIED [1]

By CHARLES H. NIMS, M.D., National Park, Hot Springs, Arkansas

WHEN one observes the history and reports of accidents in the therapeutic use of the X-ray, two circumstances are noted as the most common among the causative factors:

1. The turning over of the treatment to the technician.

2. The lack of a simple, definite system of dosage that will relieve the personal element as much as possible.

Some radiologists, so called, avoid the pitfalls of complicated computations by using one or perhaps two settings of the machine for all filtered treatments. I have seen, for example, the same setting used for carcinoma of the breast in a slight individual, and for carcinoma of the fundus in a patient weighing three hundred pounds, —*viz.*, 200 K.V. and 1 mm. copper filter. It has been the aim in our laboratory to have as many constant factors in therapy as possible, while through shifting voltage and filter extreme flexibility is attained.

Without going into the arguments pro and con as to the merits of the "lethal dose myth" and the theoretical advantages of extra short wave lengths, suffice it to say that in our practice it has been the axiom that work is done where energy is used up. In other words, that the effect on the tissues is in proportion to the rays that are used at the desired depth and not to the rays that pass through. This being the case, it is desirable to use such a variety of combinations of voltage and filters that the largest practical percentage of radiation may be lost in the tissue to be treated. Hence, the reason for my chart.

Let me state at the outset that many times the abstruse discussion of learned physicists, with their appalling formulæ and corrections for everything from altitude and latitude and longitude and diffusion and dispersion and the ionic changes in the atmosphere of the moon, are in danger of confusing us simple-minded mortals who live in three dimensions. Gazing at the rings of Saturn, we are likely to forget the thickness of the filter needed, and give a tremendous over-dose.

To simplify matters in our treatment we have varied but two factors, the essential ones of voltage and filter. (Unfiltered skin treatments are, of course, given at a much less distance.)

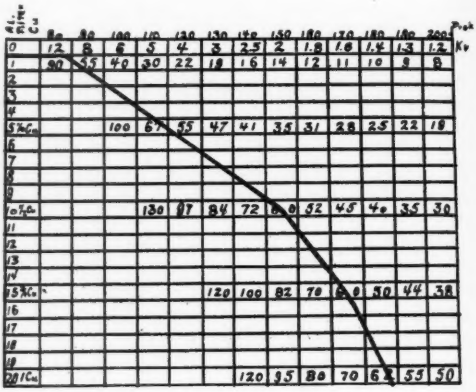

Fig. 1

With these two factors variable a chart has been constructed in which the filter varies from 0 to 20, the gradations being approximately 1 mm. of aluminum each. The voltage varies from 80 K.V. to 200 K.V. Milliamperage is constant at 5; distance at 22 inches and field covered 6 inches square. The diagonal line on the chart represents the location of the combinations that represent a safe dose extending over one hour; all figures to the right of

[1] Read before the Radiological Society of North America, Chicago, June, 1924.

the line represent time in minutes in which a safe treatment is less than one hour in length; those to the left give the time of weaker treatments.

While this chart would be subject to much criticism in the physical laboratory, it is practical for everyday use in the clinical X-ray laboratory and more than compensates for its ultra-scientific inaccuracies by its workable simplicity. As such, I commend it to your attention.

In our laboratory a set of Dr. Erskine's tables of depth dose hangs beside this chart. After determining from Dr. Erskine's tables what is the proper combination of screen and voltage to secure the maximum practical radiation for the tissue to be treated, reference is had to this chart. The figures in the designated square are the number of minutes needed to give a safe sub-erythema dose.

If it is desired to check each treatment with an iontoquantimeter, one or two settings, say at 60, are made, according to the chart. Two points on the iontoquantimeter scale are noted between which the needle discharges in 60 seconds. One or two other readings are checked with the same points. Once these points are properly located any setting may be verified by placing the chamber in place and noting that the discharge time in seconds between the two determined points equals the reading of the chart. In other words, the discharge time in seconds equals the proper treatment time in minutes. Any marked difference in discharge time from the chart reading indicates an error, and the treatment should be stopped and the trouble remedied.

These readings are made with no patient in place; if readings are made under patient the needle will discharge in 20 to 25 per cent less time, due to secondary rays from the patient's body. The readings with no filter are corrected to one-fifth of the discharge time of the iontoquantimeter needle, the wall of the iontoquantimeter chamber acting as a thin aluminum filter.

In conclusion, we have found that the combination of Dr. Erskine's tables with this chart, a time clock with or without an iontoquantimeter, make a combination producing the maximum of simplicity, and, in consequence, the minimum of liability to error from confusion.

Pyelography in renal and ureteral cases.—This is a discussion, chiefly, of the value of pyelography and X-ray in the diagnosis of hydronephrosis, renal tuberculosis, calculi and renal tumors.

X-ray and urology go hand in hand and only by this combination can we achieve the best results. Almost every condition referable to the kidneys and ureter calls for the use of X-ray. All cases of pain in the abdomen, pain in the back, blood or pus in the urine, not of venereal origin, bladder irritability not definitely ascribed to lower urinary tract obstructions, and every case of indefinite abdominal mass should be irradiated. The cystoscopic room should be fitted with an X-ray stand, because it is of prime importance from the patient's standpoint to have everything in readiness to make films after the injection is made.

Progress has been achieved in urology only by the closest co-operation of the roentgenologist and laboratory worker, combined with the most careful attention to the clinical symptoms.

W. W. WATKINS, M.D.

Modern Diagnostic Methods in Renal and Ureteral Surgery. Enoch H. Adams. Atlantic Med. Jour., March, 1924, p. 335

VACUUM MEASUREMENTS ON X-RAY TUBES [1]

By OSCAR WEINREB, E.E., CHICAGO

THE following discussion, being only a qualitative summary of measurements, will show some of the relations between the gas pressure in Coolidge X-ray tubes and their X-ray energy outputs. It will not discuss any general laws derived from the results of the measurements.

It is a fact, known since the introduction of the hot cathode X-ray tube, that occluded or residual gases, liberated from the anode, or from metal and glass parts, change the X-ray energy output of the tube. This change affects not only the total intensity, but the relative distribution of different wave lengths. The variation of the X-ray energy with the change of gas pressure is due, in the first place, to the changes in the thermionic emission of electrons, caused by the presence of the gas. The phenomena of the emission of electrons from the surfaces of incandescent metals in gases at very low pressures, were first studied by Parker, Soddy and others. Richardson and Langmuir, however, have contributed most to the problem. Richardson, in his equation, has shown the relation between the rate of thermionic emission and temperature. He has further shown that both the process of evaporation and the mathematical relations are very similar to the ordinary process of evaporation of molecules from metals. Dr. Langmuir, working from the theory of the electronic conduction in space devoid of all positively charged gas molecules, has found that emission persists even in the so-called "perfect vacuum" and that the rate of emission at any temperature is a specific property of the metal. He found that the power of emitting electrons is considerably diminished by the presence of gases, even at very low pressures. His work took into account the space charge effect, that is, the limiting of further emission of electrons, due to the repulsion of those already out. These experiments, which are of great importance for our further study, were carried out in incandescent bulbs in a pressure range from 0.00007 mm. to 0.001 mm. with an anode voltage from 40 to 240 volts. He found that although the presence of gases at low pressure reduces the electron emission, the presence of positive ions at pressures greater than 0.001 mm. reduces the space charge effect, and thus allows more current to flow from the cathode to the anode. It was found that the space charge effect at high filament temperatures is reduced by raising the anode voltage, and that it is a function of the area of the anode, and of the distances between the anode and cathode. It was theoretically deduced from these empirical laws that the normal thermionic current from tungsten follows Richardson's law exactly.

All of these laws may be applied to the thermionic current emitted from the incandescent filament of a Coolidge tube.

The high anode voltage and filament temperature applied in a Coolidge tube, even assuming the vacuum in the tube to be "perfect," reduces the space charge effect to an inconsiderable amount.

The influence of the presence of liberated gases of the X-ray output is due to other causes than the reduced electron emission. One of these is the loss of velocity of the electrons as they pass through the matter composing the gas. In other words, with increasing quantity of gas the intensity of X-rays decreases at unchanged voltage. Thomson's formula of the loss of velocity of cathode rays in solid matter can be applied in the case of gas, with certain changes, taking into consideration the ionization of the gas. The loss of velocity in cathode rays explains the enormous potential fall at the cathode in the presence of gases.

[1] Read before the Chicago Roentgen Society, November 9, 1923.

Another important point to be considered is the generation of secondary rays by the primary rays as they strike the molecules of free gas. The intensity of this scattering may be calculated by the method given by A. H. Compton and G. E. M. Jauncey. The distribution of the scattered rays and the total energy removed from the primary beam due to the scattering, may be calculated by the Jauncey equation.

The experiments for investigating the influence of gases in a Coolidge tube on the X-ray output were conducted on a Veifa transformer of approximately 150,000 volts, using disc type rectification. Milliamperes were read on an "S.H." milliammeter and voltage readings were obtained from a parallel sphere gap, calibrated with a static kilovolt meter of the electrometer type. The kilovolt meter was calibrated by exactly known high resistances, having constant temperature coefficients. The X-ray intensities were measured with an ionization chamber having a volume of thirty-five cubic centimeters, with the plates so placed that the entire X-ray beam passed between them, without striking any portion of them. The chamber was large enough to measure not only the primary beam, but also the ionization current produced by secondary rays set up within the chamber. The plates were charged to a potential of 250 volts. Since saturation would be obtained at 175 volts, ample allowance was made for complete saturation. The current in the ionization chamber was measured by a sensitive mirror galvanometer made by Carpentier, of Paris. The metal case of the chamber was grounded. The wave lengths were measured by a rotating, rock-salt crystal type spectrometer.

In all of our experiments we used two methods of measuring the vacuum in the X-ray tube. We connected the tube with a very sensitive McLeod gauge, reading the level with a cathetometer. The tube was also connected to a hot filament vacuum tube, built on the Tschudy system. The principle of this vacuum meter is based on the fact that the loss of heat from a hot wire is a function of the gas pressure surrounding the wire. In other words, when the temperature, and consequently the resistance, is kept constant, the energy input required is dependent on the gas pressure. In this way, by measuring the resistance of the hot filament, we may calculate the gas pressure in the tube. The hot filament is put as the unknown resistance in a Kohlrausch bridge, which is a very sensitive instrument for measuring resistances. In order to obtain direct vacuum readings, the millivolt meter, instead of being used as a zero instrument, was calibrated by means of a McLeod gauge to read directly in pressures. The description of the Tschudy instrument may be found in his original papers. Tungsten was used as the hot filament because of its high temperature coefficient. The filament used had a resistance of about 140 ohms, and was heated by the constant current of a standard battery to 200 degrees Centigrade. The filament was sealed in a double-walled bulb and connected to the X-ray tube by glass tubing.

The experiments were made with a Coolidge "Standard" medium focus tube, and a Coolidge 9-inch backup, made by Milles. The voltages used were 70,000 and 100,000 peak, and the milliamperages 2.5 and 5, when the tube was run at "perfect vacuum." The X-ray tube was connected with the fine side of a Gaede molecular pump, the rough side of which was pumped with a rotary pump. These experiments were carried out at pressure ranges from a very high vacuum where the space was practically devoid of all positive ions and molecules, to 0.005 mm. pressure.

At 100,000 volts (no filters were used) and constant filament current, giving 2.5 ma. in "perfect vacuum," we gradually raised the gas pressure, and at different pressures we made spectrum curves. It was found that with rising pressure the milliamperage increased, probably due to ionization reaching such a value that the bombardment of the hot cathode by positive ions gives rise to additional electrons. The effect, however, is unstable, and the current

sometimes dropped below the saturation value in the "perfect vacuum." It was found when disregarding the selective radiation of the tungsten target, and using only the continuous spectrum, that the intensity of radiation at different wave lengths decreased with increasing gas pressure, and that the intensity of the short wave lengths decreases in a larger ratio than the long wave lengths. The intensity of rays of wave length from 0.142 to 0.2 Ångström units dropped to nearly zero. These wave lengths disappeared at a pressure of 0.005 mm., while the intensity of the longer wave lengths decreased from 60 to 10 per cent. The decrease of intensity of short wave lengths with increase in pressure was small up to 0.0008 mm., while from this point up, it was very rapid.

The phenomena were similar at 100,000 volts and 5 ma. with the exception that at pressures from 0.0005 to 0.0009 mm. no considerable amount of loss of short wave length X-rays occurred. The observation that at higher filament current the amount of loss is smaller is probably due to the more rapid "clean-up" of gases at very low pressure by high temperature.

SUMMARY

An investigation of the effect of gases at low pressures in X-ray tubes showed the following:

1. That at extremely low, but yet measurable, pressures from 10^{-6} to 10^{-5} mm., no considerable decrease in relative intensity of X-rays of different wave lengths was observed. Raising the pressure to 0.005 mm., the decrease grows very rapidly.

2. The decrease of intensity in the short wave lengths was relatively larger than in the long ones.

3. The influence of gases on X-ray energy output can be detected at lower pressures, with low filament temperatures, than with high temperatures.

4. The modified Tschudy hot filament vacuum meter, checked with the Standard McLeod gauge, has proven itself to be a sensitive instrument for measuring low pressures.

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O. W. Richardson
J. J. Thomson
M. DeBroglie
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H. M. Terill
G. E. M. Jauncey
E. Tschudy

Radium therapy in carcinoma of antrum.—There are three phases of the treatment, as follows:

Pre-operative Treatment. External radiation of about 10,000 millicurie hours with radium pack at distance of 6 cm. through 2 mm. brass and ½ mm. silver. The gland-bearing area of neck is given similar radiation. X-radiation may be substituted in this stage.

Operative Treatment. This is for the purpose of exposing the affected areas so that they may be treated effectively by buried radium. In cases with intra-orbital pressure and swollen cheek close to the rim of orbit, the eye is removed, because it will react so severely to the effect of radium. Where the alveolus and palate are invaded, the antrum is best reached through a window made below. Unfiltered emanation tubes are tied in the end of a rubber finger cot, which is placed centrally or toward either wall as seems indicated. From 30 to 40 millicuries are left in place from 45 to 60 hours, changing the position at end of 24 hours if desired. An intense caustic effect is necessary for epidermoid carcinoma.

Post-operative Treatment. Frequent irrigations to combat the odor of the slough, removal of necrotic tissue and bone fragments as they loosen. If neoplastic nodules remain after the reaction has subsided, emanation tubes or needles are again used.

W. W. Watkins, M.D.

Treatment of Carcinoma of the Antrum. Frederick M. Johnson. Canadian Practitioner, March, 1924, p. 136.

OBSERVATION OF THE EFFECT OF X-RAY AND RADIUM UPON THE MALARIAL PARASITE *IN VITRO* [1]

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NUMEROUS reports as to the effect of X-ray and radium upon the spleen in various diseased conditions have appeared in the literature for a long period of time. This organ, forming, as it does, the largest lymphatic structure in the body, demonstrates the most marked evidence not only of local change, but also of general constitutional effects following the application of these agents. It is for this reason that X-ray and radium have been applied to the spleen in a great variety of diseases, such as the leukemias, splenic anemia, Hodgkin's disease, tuberculosis, and hemorrhage.

The spleen has been recognized pathologically as one of the important habitats of the malaria plasmodium. In the disease, malaria, the organ is enlarged and deeply pigmented from the deposition of acid hemitin, or hematoidin, derived from the hemoglobin of the red blood cell by the action of the plasmodium malaria. Appreciating that X-ray and radium exert a remarkable influence upon all lymphatic structures in general and the spleen in particular and that this latter structure is an important focus in malarial infection, Pais (1), Cordier (2), Froes (3) and others have considered that X-ray and radium may form a valuable aid in the treatment of malaria. More especially would such a method be indicated in refractory cases of the disease, or in those patients, thus infected, having an idiosyncrasy to quinine. The results claimed by the above-mentioned authorities would indicate that X-ray has considerable value directly or indirectly in ameliorating the infection.

With a view of determining whether or not X-ray or radium possesses a plasmodiacidal effect it was considered advisable to test their action in various dosages directly upon the culture of *plasmodium malariæ*.

It was the writer's good fortune to be able to procure such cultures from Professor Bass (4), who was the first worker to successfully cultivate the malarial plasmodium *in vitro*.

EXPERIMENTAL

Professor Bass, on October 16, 1922, procured blood from patient Lindsey (Ward 70, bed 2, Charity Hospital). Ten cubic centimeters of blood was drawn from the median basilic vein and 0.1 c.c. of 50 per cent solution of dextrose was immediately added. The blood was defibrinated by whipping. One cubic centimeter of this defibrinated blood containing plasmodia was placed in each of ten glass tubes in the usual way for cultivation of the malaria plasmodia. These glass tubes containing the living malarial parasites were then exposed to the X-ray, as follows:

Tube 1. Unfiltered X-rays; distance from target to culture tube 24 inches; spark gap of 6 inches; 4 ma.; time 4 minutes.

Tube 2. One mm. aluminum filter; distance from target to culture tube 24 inches; spark gap of 7 inches; 4 ma.; time 4 minutes.

Tubes 4 and 5. Unfiltered rays; distance from target to culture tube 24 inches; spark gap 6 inches; 8 ma.; time 10 minutes.

Tubes 6 and 7. Used as controls; were kept in a lead box protected from any possible effect of rays while the other culture tubes were being exposed.

After exposure, all the cultures were

[1] Read before the Radiological Society of North America, Chicago, June, 1924.

placed in the incubator, as usual in cultivating malaria plasmodia.

Professor Bass reports that on October 18, Tubes 1 to 6 were examined and that dancing pigment and ameboid living plasmodia were found in each. No difference could be recognized in the parasites in any of the cultures.

On October 20, Tubes 1 to 6 were again examined and living ameboid parasites found present in each of them.

Through the kind assistance of Dr. Lucien Fortier, in collaboration with Professor Bass, the following experiments were conducted at the Hotel Dieu.

On October 23, cultures of tertian malaria were exposed to X-ray and radium as follows:

Tube 1. Distance from target to culture tube 11 inches; 1 mm. copper filter and 1 mm. aluminum filter; 200 KV.; 6 ma.; time 50 minutes.

Tube 3. Immersed in water 2 inches deep; distance from target to culture tube 15 inches; 1 mm. copper and 1 mm. aluminum filters; 6 ma.; 200 KV.; time 5 minutes.

Tube 7. Distance from the target to culture tube 11 inches; no filter; 6 ma.; 200 KV.; time 5 minutes.

Tube 8. Control, no exposure.

Professor Bass reports that these preparations were all placed in the incubator and examined at the end of twenty-four hours. Stained specimens showed that the plasmodia had grown considerably in size. Unstained specimens showed many living plasmodia in each of the tubes and it was impossible to make out any difference in the activity of the plasmodia in any of the cultures.

On October 25, the cultures were again examined, at the end of about forty-eight hours, and living and active plasmodia were found in each tube. No difference could be made out in the size or activity of the parasites in any of them.

On October 23, another tube containing a culture of the same malaria plasmodia was exposed to radium, as follows:

A 50 mg. radium container, 1 mm. silver and brass filter, was fastened with adhesive plaster to the culture tube and allowed to remain for seventeen hours. When the culture was examined there were found to be many active malaria plasmodia present. Ameboid movement of the protoplasm of the parasite was easily seen, as well as active motility of the pigment. In the culture, examined the next day, then about forty hours from the beginning of the exposure to radium, some dead plasmodia were found, but not more numerous than is commonly found in cultures that have not been treated in any way.

DISCUSSION AND SUMMARY

The technic employed in these experiments was such as to permit the culture to receive X-ray energy of varying intensities; beginning with a mild dose,—so-called stimulating dose,—and gradually increasing until a destructive dose was reached. The mild X-ray dose was employed to ascertain if the parasites were influenced in their growth and development, and the dose of great intensity was employed attempting to destroy the parasites. The radium dose was employed as a destructive one.

It is appreciated that the results obtained upon these parasites *in vitro* do not absolutely vitiate the *in vivo* results reported. It is possible that the application to the spleen of the infected human case may be accompanied by contributory phenomena, such as enzymes or lysin production, that may thereby affect the parasites. This is, of course, possible, but the experiments herein reported demonstrate that the parasites are not killed or affected directly by the X-ray or radium. If, therefore, benefit is in any manner obtained through these

measures, it must be accomplished by reactionary phenomena produced by the host as a result of the X-ray and not by the rays *per se*.

I wish to extend my sincere thanks to Professor Bass, who made possible these experiments, and also to Dr. Lucien Fortier, for valuable assistance rendered.

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DISCUSSION

Dr. L. R. Sante (St. Louis): I would like to state my experience with a few cases in which we have been able to re-establish chills in chronic malaria; examination of the blood before application of the rays did not disclose organisms; examination after radiation did show organisms. I thought that might be of interest in connection with Dr. Menville's paper.

Dr. Menville (closing): The European and South American radiologists have been using X-rays and radium to the spleen for malaria. All of us who are acquainted with chronic malaria know that it is usually accompanied by an enlarged spleen, and the application of radium and X-rays will reduce the spleen. But will this cure malaria?—certainly not by direct effect upon the plasmodium.

I was intensely interested in hearing of Dr. Sante's case of the re-establishment of chills by the application of X-rays to the spleen.

Dr. Portis: I would like to ask the Doctor if this continued after the application of the X-rays.

Dr. Sante: The case I spoke of was a case of Dr. Luton's, in the City Hospital in St. Louis. The full details of the course of the disease I do not know. Dr. Luton could supply those, as he has the full record of the case.

Cancer of the uterus.—Surgical treatment is still used by the author in cancer of the body of the uterus, although this is always followed by the systematic use of deep X-ray.

In all other cancers of the uterus, surgery is not used, but the cases are referred for radium and X-ray.

During the first two years after the introduction of the use of radium the author applied this treatment only to cases which seemed hopeless from the operative standpoint, but the results have been so much better in the cases treated with radium and X-ray that surgical treatment is now employed only in the extremely early cases in which formerly nearly 100 per cent of cures were obtained.

Of course, the earlier the patient comes under treatment the better is the prognosis, but since the introduction of radium and X-ray into the treatment of cancer of the uterus, cases which formerly seemed hopeless have recovered permanently in sufficient numbers to warrant the use of this treatment.

W. W. Watkins, M.D.

Clinical Observations in the Treatment of Cancer of the Uterus. A. J. Ochsner. Canadian Practitioner, March, 1924, p. 104.

THE NEW DEPARTMENT OF RADIOLOGY OF THE ST. LOUIS CITY HOSPITAL

By L. R. SANTE, M.D., F.A.C.P., Director of the Department, St. Louis, Mo.

THE constantly increasing demand on the X-ray Department of the St. Louis City Hospital resulted, early in 1923, in an investigation by Mr. Nelson Cunliff, Director of Public Welfare of the City, of the X-ray departments of other hospitals throughout the country. As a result of this investigation a plan for the enlargement of the Department was presented to the Board of Aldermen and Bond Issue Committee, requesting, for this purpose, an appropriation of $80,000 from the $87,000,000 bond issue recently voted by the citizens of St. Louis for public improvements. This request was favorably received and the work proceeded with. The Department was completed and opened May 1, 1924. The total value of the Department, exclusive of the building, with the exception of cost of remodeling, is about $100,000.

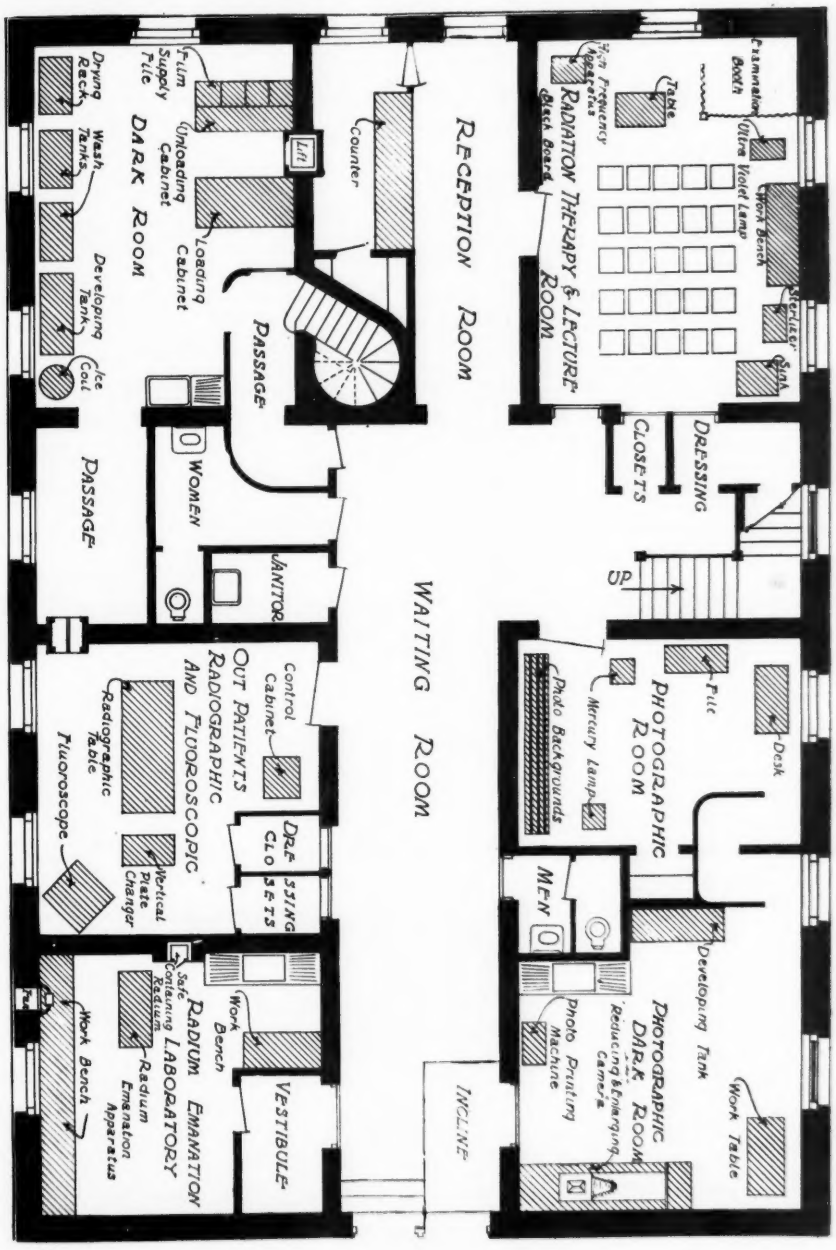
A separate three-story building, known as the Radiology Building, is utilized entirely for this work. In all, twenty-two rooms are in use. The ground floor opens onto the public street and offers an entrance for clinic patients. All floors connect by corridors with the other hospital buildings.

On the ground floor is the photographic department, the radiotherapy clinic and conference room, the X-ray dark room, the clinic radiographic room and the room for the radium emanation plant. The photographic department consists of two large rooms, one for a photographic studio, the other for a work room and dark room. Mercury vapour lights are used for studio work; a portable flash bag, which eliminates smoke, is used for work in the hospital wards. Patients treated by radiotherapy are photographed routinely before and after treatment.

The radiotherapy clinic and conference room is used for examination of patients submitted for radiotherapy and for lectures and teaching purposes. It is equipped with all apparatus for this purpose and is also equipped with high frequency and ultra violet ray apparatus. Once each week a follow-up clinic of patients treated in the Department is conducted in this room, at which the Staff are invited to be present to observe results of radiotherapy and to make recommendations for treatment.

One X-ray dark room serves all radiographic rooms. It is located on this floor, just below the radiographic and fluoroscopic rooms on the floor above, and serves these rooms by a dumb waiter. It adjoins the clinic radiology rooms, on the same floor, which it serves through a pass box. It is equipped with eleven feet of stone developing and washing tank, with thermostatic control, providing water of a uniform temperature at all times. Specially constructed cabinets are provided for loading and unloading and drying films. One of the special features of the dark room is its equipment with ventilating window sashes. These are of galvanized iron construction and operate in a second window casement which fits over the original window frame. They consist of two opaque sashes, the upper (merely a flat piece of sheet iron) serving only to exclude light and remaining permanently in place, the lower constructed of interlocking C-shaped columns of sheet iron which permit the ready passage of air, but exclude the light. When ventilation is desired, the outer window sash is raised before the darkening sash is closed; when ventilation is not desired, both the outer sash and the inner sash are closed, the inner sash in this instance merely acting to exclude the light.

The clinic radiology room will be used for radiographic examination of clinic patients and for light therapy, such as tonsil and whooping cough cases. A pass box between this room and the X-ray dark room permits the passage of films, but insures against the passage of light by a self-locking handle which does not permit the simul-

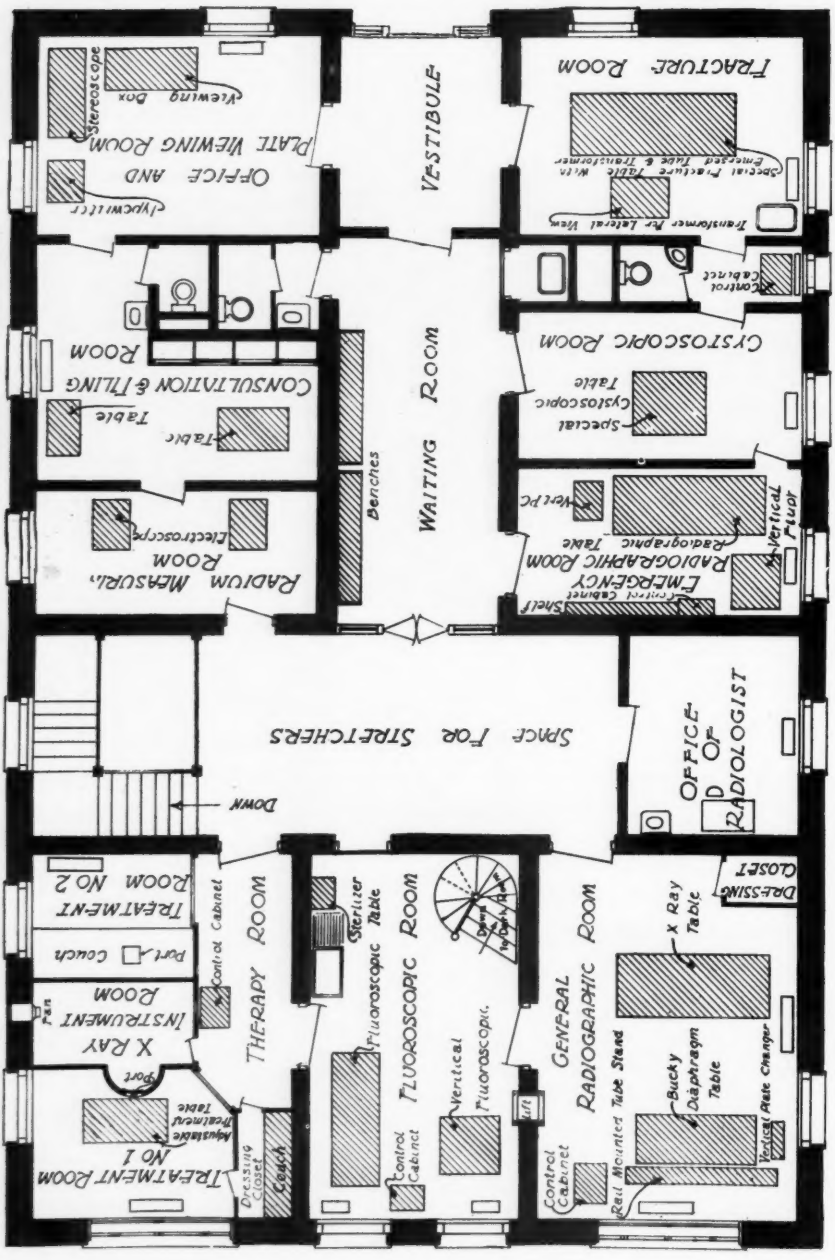


FIRST FLOOR PLAN

Fig. 1. Floor plan of first floor of the Department. The first floor communicates with both the street and hospital corridors. It is given over to the radium emanation plant, clinic, radiographic room, therapy clinic and photographic departments. One X-ray dark room supplies the clinic radiographic room on this floor through a pass box and the main radiographic and fluoroscopic rooms on the floor above through a lift.

taneous opening of both the X-ray room and dark room doors.

The radium emanation plant room is equipped with the latest type Debierne-Duane-Failla emanation apparatus, embodying no unusual feature with the exception that all movable parts, stop cocks, etc., are solidly supported by the metal framework, and an attachment permitting an interchange between the two sides allows



SECOND FLOOR PLAN

Fig. 2. Floor plan of second floor of the Department. This floor is given over almost entirely to radiological and record rooms. Special rooms are provided for fracture reduction under the fluoroscope, cystoscopic examinations, emergency radiographic examinations, routine radiographic and fluoroscopic examinations. Two deep therapy rooms are located on this floor.

pumping of either side of the apparatus independently. Five hundred milligrams of radium are in solution, forty-five milligrams are in placques and standard tubes.

The second floor, except for a small radium measuring room, is given over entirely to X-ray and administration. The three main X-ray rooms are located across

the end of the corridor—the radiographic room, the fluoroscopic room and the therapy room.

The radiographic room is directly above the X-ray dark room and is supplied from the dark room below. It is equipped with a vertical and a horizontal fluoroscope. Here, likewise, the X-ray apparatus and high tension wiring are on the floor above, high tension terminals emerging through

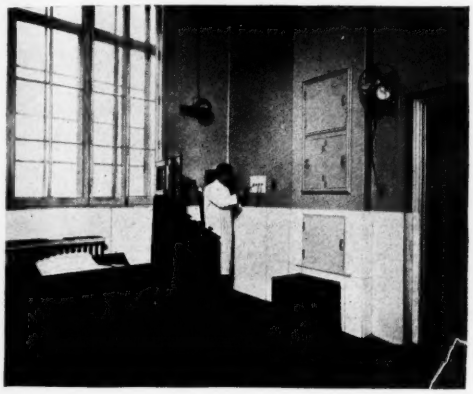


Fig. 3. All motors, transformers and high tension wiring are on the third floor, high tension terminals projecting through the ceiling wherever necessary to supply the various pieces of X-ray apparatus. All high tension switches are on the floor above and are operated by ropes running through conduits in the wall. Operator is shown in act of throwing high tension switch.

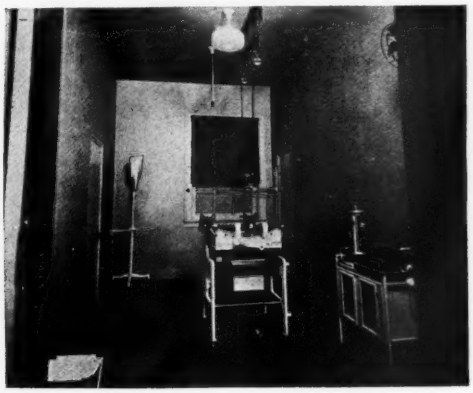


Fig. 4. Cystoscopic room. Note high tension terminals projecting through ceiling. X-ray apparatus is on the floor above.

it by a dumb waiter. It is equipped with a radiographic and a Bucky Diaphragm table. Throughout the entire Department, in the radiological rooms, we have attempted to eliminate, so far as possible, the high tension overhead wiring and X-ray machinery. This has been accomplished by putting all X-ray machinery and most of the high tension wiring on the third floor, merely coming through the ceiling wherever high tension terminals are required for the operation of X-ray apparatus. All high tension switches are on the third floor and are operated by ropes running through conduits in the walls and emerging through a wall plate conveniently located to the X-ray control cabinet. Small pilot lights, located on the high tension brackets over each table, indicate the position of the switch. This eliminates noise, diminishes the amount of dirt collecting on overhead wiring, and lessens the danger of electrical shock.

The fluoroscopic room is adjoining and is also supplied by the dumb waiter from the ceiling over both pieces of apparatus. The high tension switch, similarly operated, changes over rapidly from the vertical to the horizontal fluoroscope. This room is also fully equipped for localization of foreign bodies and their removal under the fluoroscope.

The X-ray therapy room is similar in design to the one in use at Barnes Hospital, St. Louis. It is divided into three compartments, all opening onto a small corridor. The central compartment serves to house the tubes, high tension wiring and recording instruments. The compartments on either side serve as treatment rooms, one provided with a horizontal couch (tube below the table), the other with an adjustable vertical portal. Provision is also made for tube over the table where it is required. The construction of these compartments is entirely of metal plaster lath and barium sulphate plaster. The grounded metal lathing forms a cage about the high tension apparatus which gives complete electrical protection to the patient. The barium plaster walls give protection against X-radiation, both to the operator and the patient. We have found that barium plaster made

with ordinary sand is of little value in stopping X-rays, but where barium sand is used, the result is most gratifying. Two and one-half inches of barium plaster is made with the following mixture: Barium sand, barium sulphate, Portland cement,

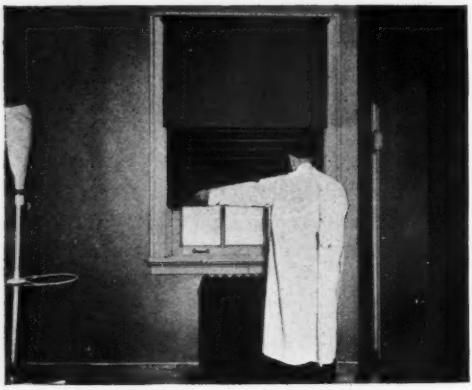


Fig. 5. Ventilating window sashes are provided in all rooms requiring darkening. These consist of interlocked C-shaped columns of galvanized iron which give free access to the air, but exclude the light. Raising or lowering the outside sash allows air to enter or excludes air entirely.

applied in eight or ten coats, is equivalent to something over $\frac{1}{4}$ inch of lead to the gamma rays of radium or 200,000 volt X-rays. Here, as elsewhere in the Department, the transformer, motor and the tube cooling system are on the floor above. Two water-cooled tubes are provided. Both tube portals are equipped with Kegerreis ionizing chambers and constant recording microammeters, to show the constant output from the tubes.

On this floor, also, are the emergency radiographic room, the cystoscopic room, and the fracture and esophagoscopic room. Being a free general hospital, a large amount of accident emergency work is handled in the Department. This emergency service is available at all times during the day and night. The radiographic room is also an emergency room insofar as it is supplied by a separate line current, and all of the work of the Department could be carried on from this room if it became necessary. The cystoscopic room is equipped with a special cystoscopic X-ray table, necessary irrigators, sterilizers, etc., for carrying on such work. The fracture room is equipped with a specially constructed fracture table, so arranged that Hawley table parts may be used for exten-

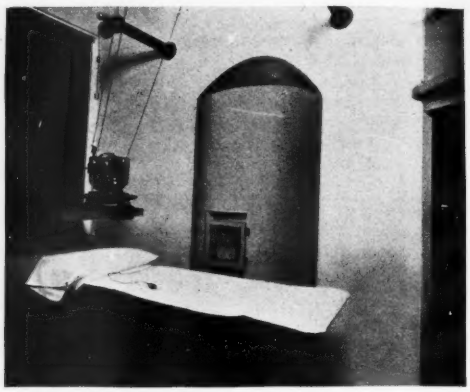


Fig. 6. One of the therapy rooms equipped with adjustable vertical portal. The protecting wall is made of barium sulphate plaster two and one-half inches thick, equivalent to something more than one-quarter inch of lead.

sion, and furnished with two complete oil-immersed X-ray units, one beneath the table, the other on the side, giving two views, at right angles to each other, without disturbing the position of the patient. This table is well suited for the bronchoscopic removal of foreign bodies under the fluoroscope. The fracture service is also a twenty-four-hour service.

The remainder of the rooms on this floor are for administrative purposes, and consist of the main office and film-viewing room, the staff consultation room, and a small private office for the radiologist. The main office is at the hospital entrance to the Department. A visible index filing system is used for ready reference to reports and films. Here, as in the office of the radiologist, a signal light panel indicates which transformers are in service in the Department. These lights are connected across the main switch of every transformer in the Department. Adjoining the main office

is the staff consultation room, for use by the members of the Staff.

An adequate personnel has been provided for the administration of the Department, consisting of—

One Chief Radiologist, Medical,
One Assistant Radiologist, Medical,
One Interne, Medical,
One Nurse,
One Chief Technician,
Three Assistant X-ray Technicians (day)
Two Assistant X-ray Technicians (night)
One Dark Room Technician,
One Physicist,
One Photographer and Retoucher,
One Secretary (Stenographer),
One Stretcher Bearer.

The successful completion of the Department was due to the complete co-operation of all of the departments of the City Administration and of the contractors and supply companies.

In addition to Mr. Nelson Cunliff, Director of Public Welfare of the City of St. Louis, who investigated the need for this Department and instituted the movement for its creation, the writer wishes to thank Dr. G. A. Jordan, Hospital Commissioner, and Dr. E. A. Scharff, City Hospital Superintendent of the City of St. Louis, for their personal interest and advice in the planning and construction of the Department; the Bond Issue Committee and the Board of Aldermen for the favorable acceptance of the proposition; Mr. E. R. Kinsey and Mr. L. R. Bowen, and all of the members of the Department of Bridges and Buildings of the City of St. Louis, who were concerned with planning or construction; Mr. E. E. Christopher, Mr. F. Hueser, and Mr. H. Updyke; Mr. Withrow, of the City Testing Laboratories; Mr. L. C. Niedner and his associates, of the Dick X-ray Company.

Pressure hour-glass stomach.—The so-called "pressure hour-glass," "cascade," or "cup and spill" form of stomach has received but little consideration. This name "cascade stomach" has been applied to that gastric deformity in which the posterior wall of the pars cardiaca forms a definite pouch and becomes distended with mixture before any descends to the lower pole. The writers have shown by experiment that this condition can be produced in hypersthenic individuals by pressure from the splenic flexure of the colon. A similar procedure does not have the same effect in a hyposthenic individual.

CONCLUSIONS

1. The results of these experiments and the investigation of the not uncommon naturally produced cases prove that the deformity referred to as "cascade stomach" is the result of retrogastric pressure which causes forward displacement of the mobile portion of the vertical arm of the stomach from the firmly fixed cardia. The most common source of such pressure is the distended splenic flexure. This condition occurs independently of any organic lesion of the alimentary tract.

2. Since the radiographic appearance of the gastric deformity simulates the true "hour-glass stomach" and since the cause of this condition is pressure, it is suggested that the term "pressure hour-glass stomach" is more descriptive to those acquainted with the fluoroscopic cascade effect.

3. With the uncomplicated case of "pressure hour-glass stomach," there occurs a definite group of symptoms characteristic of the condition.

4. The condition as described (excluding those cases which are the result of neoplasms) represents a definite clinical entity and the treatment should be directed to the underlying cause, that is, the colon, rather than the stomach.

L. R. SANTE, M.D.

A Study of the Pressure Hour-glass or Cascade Stomach. Richard A. Rendich and John F. Connors. Surg., Gyn. and Obst., June, 1924, p. 771.

OCCUPATIONAL HAZARDS OF THE RADIOLOGIST, WITH SPECIAL REFERENCE TO CHANGES IN THE BLOOD [1]

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THAT the practice of radiology entails certain hazards to health and life was forcibly impressed on its practitioners many years ago, but not until a large number of radiologists had suffered or died from radiodermatitis and cancer. Rolleston says that according to Ledoux-Labard there have been a hundred victims of cancer among radiologists. To this long roll of professional sacrifice is added from time to time the name of some pioneer who sustained his injuries in the early days, but was granted a postponement of the inevitable result. It was soon learned that this danger could be averted by the ordinary precautions which are now habitually employed. So effective are these methods in the prevention of skin lesions that the radiologist has apparently been lulled into a false sense of security from all harm. His serenity is not due to ignorance, but to an unwarranted optimism in the face of his abundant knowledge. He is fully aware that an intact skin may cover a multitude of internal changes wrought by irradiation. These changes are the expected result of radiotherapy; they are found at the necropsy table, are substantiated by experiments on animals, and are demonstrated conclusively by the microscope and the test tube. The literature on deep irradiation effects is overwhelming, both in magnitude and complexity, and the references here appended constitute but a small fraction of the total.

Studies which are almost fascinating in interest have been made of irradiation effects on virtually every organ and tissue of the body, including the digestive tract, blood, bones, heart, lungs, liver, pancreas, eyes, brain, nerves, kidneys, spleen, gonads, and ductless glands. Findings have not always agreed, nor is this surprising in view of the different conditions under which the tests were made. Notwithstanding discrepancies and contradictions, it is impressive to note that alterations of some sort were found almost constantly, and that in many instances they were produced by moderate or even minute amounts of irradiation.

Among generally accepted facts and theories the following are especially pertinent to the present theme, and will bear repetition, however familiar they may be:

1. Radium and the X-rays produce biologic effects which are essentially alike.

2. These effects vary according to the amount of irradiation, and range from stimulation to destruction (36, 44, 46, 64, 85, 87). Although supported by a great preponderance of evidence, the occurrence of stimulation has been denied by Pordes and others. Holzknecht insists that the X-ray is like curare, and that even in small amounts it is destructive, never stimulative.

3. Cells differ in sensitiveness to irradiation, and certain varieties are especially susceptible. Easy vulnerability of the sperm cells is well established. Lymphocytes, endothelium of blood and lymph vessels, immature cells, and cells in the process of mitosis are highly sensitive.

Susceptibility of the blood and the hematopoietic system to irradiation has been shown convincingly by experiments on animals and by tests of patients and radiologic workers. Levin regards the lymphocyte as the most sensitive cell in the animal organism, and asserts that the greater the square surface of entry of the rays, the more severe is the general effect on the blood. Béclère found that in some persons even a single application of the rays causes a permanent change. As might be expected from varying technical factors, the experimental re-

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sults are not uniform. In general, however, they show that the circulating lymphocytes are increased in number by small doses (41, 55, 77), and decreased in number by large (41, 64, 67). Among radiologic workers there is frequently an increase of lymphocytes, either absolute or relative (1, 7, 24, 58, 78), but with severe or long-continued exposure a reduction may occur (7, 54). The polymorphonuclear count is usually diminished, absolutely or relatively (1, 53, 54, 58, 78), although this may be preceded by an initial increase (76, 84). Marked increase of the eosinophiles has been found in radiologic workers (58, 78, 84, 86). The red cells are more resistant than the white, but restoration is slower (4). Radiologic changes in the erythrocytes run the gamut from a slight increase in number and augmentation of the color-index (1, 15, 30, 84) to diminution and hemolysis by intense doses (29, 60). Most investigators have found hastening of coagulation (44, 47, 57) although the opposite has been reported (65). Reduction of blood pressure is a common finding (15, 58, 88), various alterations of the blood chemistry have been noted (9, 10, 28), and histologic changes in the bone marrow are well-confirmed experimentally (24, 25, 51, 80).

Evidence is increasing that the intestinal mucosa is markedly sensitive. In dogs, Hall and Whipple produced a necrosis of the epithelium lining the intestinal crypts. Mottram observed that very small doses of radiation, less than would be required to affect the testes or skin, altered the production of intestinal mucus. Intestinal ulceration following deep therapy is by no means unknown.

The mooted matter of personal idiosyncrasy has a bearing on hypersensitiveness to radiant energy, and while this factor has perhaps been exploited unduly, it has some basis in fact.

4. Irradiated cells have a lowered resistance to other unfavorable influences, including trauma and possibly certain infections. Moreover, as Loeb has pointed out, "chain reactions" may occur, one effect giving rise to another, with ultimately severe results.

5. Radiologic workers, so far as they themselves are concerned, are inclined to lay too much stress on the difference in effect of hard and soft rays, and to assume, quite inconsistently, that hard rays, regardless of their aggregate amount, are unlikely to affect the operator. With respect to the skin there is admittedly a difference between hard and soft rays. Martius has shown that rays with a wave length of 0.56 have nearly four times as great an effect as rays with a wave length of 0.325. On the other hand, only hard rays can reach the deeper tissues, and hard rays are in daily use for that purpose. Hall and Whipple found not only that the intestines of dogs were gravely affected by hard rays, but that fatality increased in ratio to the spark gap. Mottram considers it probable that the gamma rays of radium have a destructive action on bone marrow which relatively soft beta rays may not possess. Regaud is cited by Withers as asserting that gamma rays and X-rays of very short wave length are "elective poisons" for nuclear chromatin.

6. The cumulative effect of radiation, which the radiologist guards against so zealously in therapy, cannot be ignored in estimating the chances of injury to himself. Cells affected by the X-rays or radium and re-exposed before sufficient time has elapsed for complete restoration to normal, are altered on an ascending scale, and in the case of hypersensitive cells it is logical to assume that even minute doses frequently repeated may have momentous consequences to their growth and function.

7. By analogy it may be reasoned that radiant energy, like certain drugs, may set up an increase of cellular resistance. This is indicated empirically by the decreasing responsiveness of newgrowths to irradiation. Warren and Whipple have found a suggestion of increased tolerance of dogs to subsequent X-ray exposures. Loeb offers the hypothesis that new cell races

which are more resistant than their ancestors may develop. The fact that many radiologists have been exposed for years, yet survive in apparent good health, is an item of corroboration.

However, the profession cannot safely emphasize the hypothesis of immunization, for there is also evidence that an opposite condition, that of anaphylaxis, may develop in patients. Granting that either immunization or anaphylaxis may occur, the exact circumstances likely to induce one or the other effect are not known.

8. To the foregoing premises is to be added the fact that radiologists are not and cannot be shielded completely from irradiation while pursuing their vocation. Protection can only be relative, and the gamma rays of radium and X-rays of short wave length penetrate ordinary barriers appreciably. The fluoroscopist and the dispenser of radium and high voltage therapy are especially exposed. Even with customary safeguards, some degree of scattered and secondary irradiation is inevitable. Moreover, not all radiologists are scrupulous in the exercise of care, and some of them are daring to the point of recklessness. Admitting that with routine measures of protection the radiologic worker receives only minimal doses, these are repeated day after day through the years. Even if their effect is only stimulative, the results of long-continued stimulation are to be reckoned with.

In view of these data the injuries to radiologic workers which may eventually come to light offer a broad theme for conjecture. But the radiologist, confident of his defense against radiodermatitis, and quite unterrified by the chance of emasculation or lesser damage, waits for absolute proofs that more serious dangers threaten him. Such proofs have begun to appear, and, in consonance with the results of experimental research, lesions of the blood and at least one authentic case of intestinal injury lead the van.

INTESTINAL INJURY

With regard to intestinal injury, only a single case, that of the English radiologist, Barclay, is of sufficient gravity and sufficiently confirmed to warrant recording. After twelve years of work, including much screening without an apron, Barclay had several diarrheic attacks with loss of weight. Mucous casts were noted in the stool on a few occasions. On ceasing work the attacks disappeared in three weeks, and on returning to duty they recurred in from eighteen to twenty days. This cycle was confirmed eight or nine times. Since using additional protection he has been comparatively free from such troubles.

It would be interesting to know whether or not the gastro-intestinal complaints of certain other colleagues have any relation to their occupation. For example, an associate of many years recently had a severe hematemesis and diarrhea, the latter recurring on several occasions. A Western radiologist gives a similar history. In both instances a thorough physical and radiological examination failed to reveal an adequate cause. While no definite relation to irradiation has been established in either case, a systematic study of radiologists from this standpoint might develop valuable information.

FATALITIES FROM DISEASE OF THE BLOOD

No less than six deaths from aplastic anemia have occurred among radiologic workers.

The first, a classic and oft-repeated story, was that of Dr. Tiraboschi (18), an Italian roentgenologist, who, after fourteen years' service with little or no means of protection, died of a "profound essential anemia" in 1914. Three years prior to this he had a severe nervous breakdown, but was able to resume his duties after six months. Although he showed an increasing pallor and complained of loss of strength his nutrition was good, and he continued to work until his death. Among other abnormalities, necropsy revealed extreme testicular atro-

phy, diminution and hardening of the spleen, and pronounced alterations in the marrow of the ribs.

Next in chronologic sequence were the three cases in radium workers reported by Mottram (53) in 1920. One of these, a woman aged thirty-six years, had been engaged in the work for eight years, during which time she was in excellent health. Pallor developed after a holiday of two months. Her red cell count and hemoglobin progressively diminished; there was definite leukopenia and anisocytosis, and death occurred after seventy-three days. Another was a man aged thirty-three years, a worker with radium for three years. He, too, was taken ill after a month's holiday, and the blood picture was similar to that in the preceding case. Death ensued after three months. The last case of the trio was a man aged fifty years who had worked with radium for ten years. His fatal illness was of short duration. The diagnosis of aplastic anemia was supported by the blood findings.

Dr. Ironside Bruce, of England, was the fifth victim (40). Bruce was in his early forties, and had been engaged in radiology for about eighteen years. He was of good physique, had lately gained in weight, and his general health was never better. In October, 1920, a blood count, made quite accidentally, showed a slight diminution of the red cells and hemoglobin. From that time until his death, in March, 1921, the red cells, hemoglobin and white cells steadily diminished. Low blood pressure, a relative lymphocytosis and a poikilocytosis were other features.

The sixth death recorded was that of Dr. Nordentoft (24), a Danish radiologist who had employed X-ray therapy for twelve years and was not always careful in taking precautions. Some years ago he noted testicular atrophy. In November, 1921, he complained of fatigue, and an examination of the blood disclosed a slight reduction of the red and white cells. Several months later he again became weak and dyspneic. At this time diminution of red cells was marked: anisocytosis, microcytosis and poikilocytosis were also pronounced. Demoralization of the blood picture rapidly became extreme, and he died within another month.

Dr. F. M. Sylvester, of Oak Park, Illinois, writes the following interesting letter:

"About two years ago, I was doing some research work towards the establishment of a so-called lethal cancer dose. At this time I was working with a kilovoltage varying from 160 to 280. My protection consisted of a booth of one-inch pine covered with one-eighth inch lead and quarter-inch beaver board. This booth was completely covered, with the exception of the floor, which had no protection. The booth was approximately eight feet from the tube. I was spending on an average of four hours an evening in this booth, with the tube in constant operation during this time.

"The first manifestation of illness was the usual tired, weary sensation. As these symptoms became more pronounced, I naturally suspected the X-ray, and made several tests around through other parts of my laboratory to see if I was getting irradiation either from radium or from other machines. These tests proved negative to such an extent that I felt satisfied that there was perhaps another cause. In the meantime an anemia developed, the red count dropping from 5,200,000 to less than 4,000,000. I now made several tests with an iontoquantimeter within the booth, and found that radiation was coming in through the floor. In fact, this was to such an extent that an eight by ten film could be fogged in eight minutes' time operating with a kilovoltage of anything above 200 k.v. I immediately had the floor of the booth covered, and at Dr. Darnell's suggestion, walled off a room, and covered the same with one-eighth inch lead. This room was utilized for the patient, thereby giving me a protection of the one-eighth inch lead on the booth, as well as the one-eighth inch lead in the treatment room.

"I now found, on tests, that there was no further evidence of perceptible radiation. The damage, however, in my case had been done, and the red count dropped to 2,500,000. At this time I was confined to my bed and my life despaired of. Relative to blood changes, there were several things of interest that we noted. The blood pressure, which normally had been 130 systolic, fell to 105. (This, by the way, has never come back beyond 110.)

"The alkaline reserve at the beginning showed a relative increase. This gradually fell, as you can see by enclosed charts, and has never returned to a normal point."

Six blood counts made between June 15 and August 21, 1922, tell a graphic story of Dr. Sylvester's illness, and are tabulated herewith:

TABLE 1

Date	June 15	June 29	July 5	July 18	July 28	Aug. 21
Erythrocytes	5,200,000	3,900,000	3,000,000	2,500,000	3,500,000	4,200,000
Leukocytes	8,000	6,500	5,000	8,000	7,000	8,000
Hemoglobin %	80	65	55	41	61	70
Color index	1.25	1.00	1.09	1.21	0.84	1.14
Coagulation time	4 min.	3 min.	2.5 min.	5 min.	4 min.	3 min.
Erythrocytes						
Color	normal	pale	pale	pale	pale	pale
Size	normal	small	small	small	small	normal
Shape	normal	crenated	crenated	crenated	oval	oval
Poikilocytes	0	+	+	+	0	0
Polychromatophilia	0	+	++	++	0	0
Basophile granulation	0	0	0	+	0	0
Microcytes	0	+	+	+	+	0
Macrocytes	0	0	0	0	0	0
Microblasts	0	0	+	+	0	0
Normoblasts	0	+	0	0	0	0
Megaloblasts	0	0	0	0	0	0
Howell's Particles	0	0	0	+	0	0
Lymphocytes						
Sm. mononuclear %	27	30	30	14	24	23
Lg. mononuclear %	6	8	14	10	8	10
Transitionals %	2	0	0	0	0	0
Neutrophiles						
Mononuclear %	0	0	0	0	0	0
Polynuclear %	63	60	54	70	65	56
Eosinophiles %	1	2	2	3	3	1
Myelocytes %	0	0	0	0	0	0
Basophiles %	1	1	0	3	0	0
Mast cells %	0	0	0	0	0	0
Free nuclei %	0	0	0	0	0	0
Alkaline reserve %	7.6	7.8	6.4	6.1	7.0	7.3
Hydrogen-ion %	6.3	6.2	6.1	6	6.3	6.7

punctilious as to protection and sometimes omitted wearing an apron. During the last year he complained of extreme exhaustion at the end of the day's work. Early in

LYMPHATIC LEUKEMIA

The chief stimulus for reviewing this subject was the recent death of Dr. Walter Mills, of St. Louis. Dr. Mills was forty-six years old and had been engaged in clinical roentgenology of the digestive tract for about fourteen years. The volume of his work was large and consisted chiefly of fluoroscopic examinations. He was not

1924 a blood count, made casually, showed signs of a lymphatic leukemia. Shortly afterward he discovered some swelling of the cervical and inguinal lymph nodes. He came to the Mayo Clinic in February and the existence of the leukemia was confirmed. Blood counts, details of which are tabulated herewith (Table 2), revealed 25,000 to 30,000 leukocytes, 96 per cent

of which were lymphocytes. The red cells numbered 4,220,000 to 4,600,000 and the hemoglobin was 65 to 70 per cent.

TABLE 2

	February 4	February 6
Hemoglobin, %	70	65
Erythrocytes, millions	4.60	4.22
Leukocytes	25,800	30,400
Lymphocytes, %	96.5	96.5
Neutrophiles	2.0	3.5
Platelets	240,000	310,000
Anisocytosis	slight	slight
Poikilocytosis	slight	slight
Polychromatophilia	slight	slight
Coagulation time (Bogg)	6 minutes	

Shortly after coming to the Clinic, Dr. Mills developed appendicitis, and operation became imperative notwithstanding the unfavorable circumstances. Death followed three days later.

Various interpretations of Mills' case are obvious. Exposure to the X-rays may have had no causative relation to the leukemia. Indeed, the X-rays may have mitigated the disease. On the other hand, the X-rays are capable of causing malignant lesions of the skin and may have induced this malignancy of the blood. Further, Mills' father died from cancer, so that the hereditary factor, emphasized by Slye, was present. At all events, the case is worthy of publicity for future consideration.

Only two references to a possible relation between exposure to irradiation and lymphatic leukemia were discovered in the literature. One was a statement in 1911 by von Jagic and his collaborators, as follows: "Several years ago a Vienna roentgenologist died of lymphatic leukemia. At the same time it was announced that a practicing roentgenologist of Munich had passed out with the same disease. One of us (Schwarz) had the opportunity of observing a case of leukemia in a chemist who had been occupied for a long time in the production of radium. Recently we have received the news that an American roentgenologist had also fallen a victim to this disease." Unfortunately, von Jagic gives no specific details, and the identity of the American roentgenologist referred to is unknown to us. However, his language is declarative regarding two of the cases, and is entitled to credence. In a late paper, Amundsen (24) states that the lymphocytes of radiologic workers are regenerated very rapidly, and the over-production may be regarded as an attempt to compensate for the leukopenia. Hence, he says, "the cases of lymphatic leukocythemia that are reported as having occurred among radiologists may no doubt be interpreted as a lymphocytic regeneration overshooting the mark."

In this connection, it might be pointed out that deaths of radiologists are often reported without any information as to the cause. For the welfare of the profession, it is to be hoped that in future the records of all such deaths will be given in detail, and with due attention to the occupational phase.

INJURIES AND FATALITIES FROM ELECTRIC CURRENTS

Besides the effects of radio-activity, the roentgenologist is exposed to another hazard, that of electric shock. Rare, indeed, is the roentgenologist who has not witnessed or been the target of such shocks. Fatalities to patients have happened, and records of most of these can be found in the annals of medical jurisprudence. The death of Dr. Jaugeas, December 2, 1919, (13) should not be difficult to recall. Dr. Clatus Cope, a dentist of Seymour, Indiana, was electrocuted July 16, 1920. Doubtless this list is not complete, for personal accidents are not indexed as carefully as scientific papers.

THE PERSONAL EQUATION

Injuries and fatalities to radiologists from cancer, aplastic anemia, lymphatic leukemia and electric shock thus assume

considerable proportions. The reaction of the profession to them will be determined by the personal equation. The optimist and the pessimist can each find strong arguments in the whole array. In the one view, dermatitis and cancer belong to ancient history, irradiation has not been proved with mathematical precision to be a cause of aplastic anemia or lymphatic leukemia, and accidents are always possible to those who work with electric currents. In the other view, radio-activity is so dangerous that its employment should be left entirely to those who are willing to assume the most extraordinary risks.

As usual, the truth is probably between these extremes. In that case, the optimists, who seem to be in the majority, must be roused to a proper sense of their unnecessary jeopardy. Fear that the eligibility of radiologists for life insurance might be impaired by too much publicity has perhaps inspired a certain modesty of opinion in the past. But this attitude is shortsighted, for with open recognition of his perils the radiologist will employ more effective means to avert them.

PREVIOUS WARNINGS

Warnings of hidden dangers to radiologists have not been lacking. Von Jagic and his associates made examinations of several roentgenologists in 1911 and showed that blood changes had occurred. Portis published the results of similar tests in 1915. Later, the deaths of Tiraboschi and Bruce were made the occasion of urgent admonition by editorial writers. Five years ago Mottram began to write extensively for the benefit of radium workers, and his efforts were seconded by Pinch. In 1920 and again in 1921, de Courmelles emphasized the gravity of the situation. In 1922, Caffaratti, Amundsen and Pfahler each gave serious attention to the subject of hematic changes in radiologists. Last year Faber reported the death of Nordentoft, and again cautioned other workers. Hemler, in 1922, and Shearer, in 1923, wrote of the hazard from electric shock and the methods of avoidance.

Pfahler's paper deserves more than passing mention. He canvassed the radiologists of America to learn whether they were sustaining hematic changes or other injury, and received many replies. In general, the professional workers had a slight leukopenia and a relative increase of lymphocytes. A few had an increase of eosinophiles. Twelve had delayed clotting of the blood. Systolic blood pressure was decreased, as a rule. While in most instances the changes in the blood picture were only slightly beyond normal limits, Pfahler regarded them as probably significant of excessive irradiation and as danger signals. In the main, nurses and lay assistants seemed intact, but ten of them had blood changes or other abnormalities, or were receiving excessive exposure. Many of the roentgenologists reporting to Pfahler complained of marked fatigue from their work, but Pfahler believes that similar fatigue would follow equal activity in other occupations. It is noteworthy, however, that radium workers have also complained of fatigue.

PREVENTION OF INJURY

Viewing all this evidence, even in the most liberal light, the conclusion is inescapable that many radiologists are being harmed in their daily work and are menaced by graver injuries. To avert these injuries it is necessary, first of all, that the radiologic worker be impressed so thoroughly with his danger that he will take adequate precautions. Either the methods of protection now in common use are not effective, or the worker is careless in their application. As Pfahler and others have said, not only the means of protection but the will to use it is requisite.

It is needless here to review protective measures at length, for the principles are familiar and easily applied. It might be emphasized, however, that the worker should be shielded not only from direct rays, but also from secondary irradiation

which may reach him from any angle. For the radiographer efficient protection can be secured by simple means, but in fluoroscopy and radiotherapy more elaborate measures are required. Protection from irradiation and prevention of electric shocks have been given more attention of late by the manufacturers of X-ray apparatus.

Even with all practicable safeguards, a certain degree of exposure cannot be evaded. Laboratories doing a large volume of work should, therefore, have a reserve personnel to permit alternation of service or frequent holidays. Workers should repeatedly be cautioned to receive the least possible amount of irradiation consistent with the performance of their duty. Modern life, regardless of occupation, has an abundance of risks, and additions are superfluous. Besides taking all reasonable precautions, workers should have frequent medical examinations.

One of the first maxims learned by the physician is "*non nocere*" (harm not), and he is seldom faithless to it with regard to his patients. Is his own body less worthy of care?

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DISCUSSION

Dr. H. J. Ullmann (Santa Barbara): Reference was made to a statement by Hall and Whipple regarding the decreased lethal dose when a longer "gap" was used. If one will refer to this article, square the gaps and compare with the lethal doses, he will find that the doses are inversely proportional to these squares. The authors were evidently not familiar with the physical laws governing X-ray output when they assumed that rays generated by a higher voltage were more lethal, for no allowance is made for the increased intensity produced by this increased voltage. When such an allowance is made no difference in the lethal effect is found.

Dr. Albert Soiland (Los Angeles): I believe that Dr. Carman's paper should be given great thought and consideration. There is no one phase of the work we are doing that is more important to us, both physically and from a medico-legal aspect, than protection—and that means not only to ourselves and our technicians, but to the patients we undertake to treat or examine. I have presented this subject on former occasions and am always glad of an opportunity to reiterate, because I believe it is the most important radiological subject we have to deal with to-day. Many years ago, when Dr. Carman was even younger than he is to-day and I used to visit him, I found him sitting behind his fluoroscope, with his bare hands palpating many patients daily. Also, many years ago when Dr. James T. Case was young and handsome, he was doing his fluoroscopic work on the overhead table, which he assumed was fully protected. On one visit I took his fluoroscope and walked around the table with it and had no difficulty in observing the leg bones of Dr. Case as he stood over the table. However, I see that he is still alive and I guess he is

now keeping out of harm's way. In New York last week I saw something which bordered on sheer neglect. I went to one of the large hospitals where deep therapy was being done by someone who is highly intelligent and, I presume, knows every detail of the work. He was operating two high voltage tubes in rooms where open wooden doors with no lead protection permitted the attendants and waiting patients to absorb whatever direct and scattered radiation came their way. In the light of present-day knowledge of the biologic reactions to radiation, this is inexcusable. We should all take to heart what Dr. Carman has said and impress upon ourselves the necessity of protection against every form of unnecessary radiation.

Dr. G. E. Pfahler (Philadelphia): I want to emphasize what Dr. Carman and Dr. Soiland and Dr. Ullmann have said. There is nothing so important to us to-day, and really so important to the advancement of this science, as this question of protection. We must not, on this question of protection, limit ourselves entirely to the roentgenologist, but extend our consideration to the patient. These high voltage machines that are being distributed through the country and installed in some of the hospitals, without the thought of even having a technician do the work, without the supervision of a trained radiologist, make those of us who know the dangers very fearful. We must not imagine that we get protection, especially from these high voltage rays, by simply standing an alleged screen up in front of us. I tried this out very thoroughly in my own laboratory,—not with a screen but by the following process. I placed my high voltage tube under a concrete floor sixteen inches thick; I covered the top of the concrete floor with a quarter of an inch of lead; the only communication from the basement was a small door, and one had to pass around the hallway in order to get up. I thought that that would give protection, because the only rays that came to the room were the beams of rays that passed through the patients. We soon learned, however, that we had rays not only all over this room but in the neighboring rooms, and we did not get protection until we leaded all of the rooms and doors about the space in which we had only a column of rays coming through. When I see, as we all can see, deep therapy equipment with simply a glass bowl around the X-ray tube, and see patients and physicians and assistants walking around this glass bowl, assuming that they have protection, it just makes one shudder. As Dr. Soiland has well said, a wooden door is no protection,—you must have the leaded wall complete to the ceiling and all the air shut off, because the air itself will carry this radiation through to the adjoining room.

Now test yourselves, as I suggested in my paper to which Dr. Carman kindly referred. Put some dental films in the place where you are standing, and leave them there for a time until you think they are fogged, and test it out. Carry a dental film in your pocket and see how long you can carry it until it becomes fogged. You would be surprised at yourself, when you are working around either radium or X-rays, no matter how careful you are. Then make further tests by examining your blood from time to time.

All these things furnish indices of danger. We must all be more careful, not only in protection against the rays, against the electrical dangers, but also in getting sufficient rest, for we are adding to this over-exhaustion the intense work we are doing, and we must overcome the products of waste in our body plus this radiation effect.

Dr. L. T. LeWald (New York): I think that each laboratory should be inspected according to the regulations of the Board of Health in New York City.

The Board needs support just like this, however, for there is the other side to it: a physician claims, by right of his license, that he can use *any* means *he* sees fit to treat patients, and we have to prove that he

has not that right, for the public must be protected, and even the individual himself. The Board needs your support of the code recently passed, and if New York City goes into court on this problem, as it might on a case such as Dr. Soiland has mentioned, it will have to be tried out. The orders of the Board can be carried out under the police regulations of the city, and the only stumbling block is the question of whether we are going to have the support of the medical profession itself. When it comes to a question as to what the Board of Health may adopt as a standard for adequate protection, we might insist upon these suggestions which were made to-day, which will be brought to the attention of the New York Board of Health. For any violation of the code, even though a laboratory has a license, that license may be revoked. I am sure we will have the support of the court in this matter, if we have the support of the profession. The New York City Code governing this matter follows:

X-RAY LABORATORIES REGULATED

At a meeting of the Board of Health of the Department of Health of New York City, held January 26, 1922, the following resolution was adopted:

Resolved, That Article 7 of the Sanitary Code be amended by adding thereto a new section to be numbered 107, to read as follows:

Section 107. No person shall maintain, operate or conduct an X-ray laboratory or advertise or hold out to the public that an X-ray laboratory is maintained, operated or conducted, wherein radiographs are taken, diagnoses made or human beings examined or treated by X-rays, without a permit therefor issued by the Board of Health, or otherwise than in accordance with the terms of said permit and with the Regulations of the said Board.

Regulation 3. Precautions against danger.—Every X-ray laboratory shall be so constructed as to confine within the operating room the rays emanating from the machine and it shall be equipped with suitable and necessary appliances and devices at all times when the X-ray machine is in operation for the proper protection of patients, operators and all other persons or property adjacent, contiguous to or coming in contact with the electrical or other current or force or spark generated or incident to the operation and use of the X-ray machine.

Regulation 4. Permits may be revoked in the discretion of the Board of Health.

DR. J. D. SOUTHARD (Fort Smith, Ark.): It seems to me this is one of the most important questions we can possibly consider, and as I have listened to the discussions of the leaders in our profession, giving their experience, it has occurred to me that we ought to at least appoint here at this time, a committee of three men, such as Dr. Carman, Dr. Soiland, and Dr. Pfahler, to formulate something like a minimum of precaution to be taken by every one in the work that we are doing—something as easily practicable and simple as possible—and submit it to this association and let it be published, and then that we all should resolve in our own minds that we will comply with it. I am a new member and do not know whether anything of this kind has been or is being done or not.

A RADIOLOGIC STUDY OF SOFT-TISSUE TUMORS[1]

By CHARLES G. SUTHERLAND, M.B. (Tor.), Associate in Roentgenology, Mayo Clinic, Rochester, Minnesota

ALTHOUGH there are many soft-tissue tumors that cannot be differentiated roentgenologically, there are many others presenting more or less characteristic features, and it is my purpose to describe these and to point out the distinguishing signs of the various groups. In a review of one hundred and three soft-tissue tumors, I found sixty-two benign and forty-one malignant.

BENIGN TUMORS

Lipomas	11
Fibro-lipomas	5
Chondro-fibro-lipoma	1
Hemangiomas	2
Lymphangioma	1
Myxoma	1
Fibro-osteoma	1
Xanthoma	1
Osteochondromas	3
Chondroma	1
Aneurysms	4
Cystic tumor	1
Neurofibromatosis	4
Sebaceous cyst	1
Elephantiasis	3
Elephantiasis or vegetating dermatitis	1
Congenital anomalies	2
Collections of pus in the soft tissues	3
Semimembranosus bursæ	2
Prepatellar bursitis	3
Calcified tuberculous glands	2
Branchial cyst	1
Cartilaginous tumor of the larynx	1
Inflammatory cyst with foreign bodies	1
Recurring cartilaginous tumor of arm	1
Tuberculous tenosynovitis	2
Tendon ganglion in the wrist	1
Tumors in tissues of the back	3

CLINICAL AND PATHOLOGIC DATA

There are many types of lipomas, or fatty tumors, but I shall discuss only the subcutaneous type here. They arise from the subcutaneous layers, and are said to be most abundant over the trunk and the trunk ends. In this series two were in the region of the shoulder, six in the thigh, two in the forearm, and one over the inner aspect of the right ankle. The tumors, for the most part, are freely movable, soft, definitely encapsulated and lobulated, and not fluctuating. Fibro-lipomas, or fatty tumors rich in connective tissue, occurred as follows: two in the thigh, two in the leg and one in the forearm. These tumors are less soft, denser in consistency, and less inclined to be lobulated. The fibro-chondro-lipoma, a fatty tumor containing an increase of connective tissue and cartilage cells, firm, hard and more likely to be fixed, occurred in the thigh. The hemangiomas, tumors composed of newly formed vessels, which may or may not be thrombosed, occurred one on the internal surface of the right leg at the lower margin of the middle third of the tibia, and the other on the inner upper third of the leg. There was one lymphangioma, a tumor composed of newly formed lymph spaces and channels, extending over the upper four-fifths of the right leg. Myxoma, a soft translucent growth made up of variously shaped cells of connective tissue and capillary vessels encased in a jelly-like matrix, was seen once, in the plantar surface of the foot. One fibro-osteoma with secondary fibro-cytoplasia involved the tissues in the inner middle third of the thigh. A single xanthoma, a tumor consisting of fibrous and fatty tissue containing yellow pigment, was seen just below the head of the proximal phalanx of the middle finger on the radial side. Ordinarily an osteochondroma cannot be classified as a soft-tissue tumor, but there were three in this series. One arose from a knocked-off piece of the patella and lay just without the synovia, bulging into the knee joint; one arose by a pedicle just posterior to the lesser trochanter of the femur, and the third, apparently taking origin from the spinous process of the third cervical vertebra, was seen in the soft tissues of the neck. The latter was pathologically considered degenerating hemorrhagic

[1]Read at the annual meeting of the Radiological Society of North America, Rochester, December, 1923.

osteoma. There was one chondroma involving the soft tissues of the thumb. Four of the series were aneurysms, three arterial, and one venous. One was in the inner middle third of the forearm, one directly over the right elbow joint, and two were in the thigh. One in the thigh was a venous aneurysm; the other, an arterial aneurysm in an amputation stump, in which at operation an aneurysm of the femoral artery filled with an organized, laminated clot, was found. A cystic tumor in the upper half of the radial aspect of the forearm, which had developed following a fall seven years before, was not painful; it had become gradually less progressive, and was not operated on. A small tumor over the base of the proximal phalanx of the index finger proved to be a sebaceous cyst with a partially calcified wall. Neurofibromatosis, elephantiasis and congenital anomalies were considered by the pathologists as one group, more in the class of fibromatoid reactions of subjects predisposed to chronic disturbances of nutrition, than that of true neoplasm, in which the subjects suffer a congenital malformation of the ectoderm, which under a great variety of exciting causes may slowly or rapidly develop one or more of the manifestations of this disease. The tumors are usually soft and cellular, the growth surrounding the nerve, involving one side, or connected with the nerve trunk by a thin pedicle. The larger tumors frequently involve other structures of the skin, as the sebaceous and sweat glands. In this series all were in the thigh or the leg.

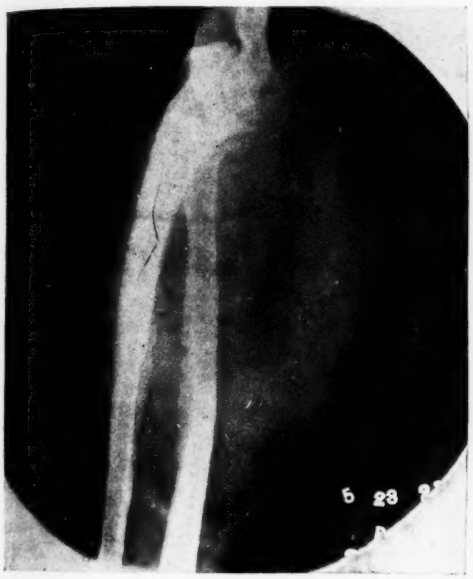

Fig. 1. Lipoma of the right forearm.

Fig. 2. Fibro-lipoma of the leg with diffuse calcareous deposits.

There were three cases of collections of pus in the soft tissues: (1) an abscess in the soft tissues of the forearm in an infant (clinically this was considered tuberculous; later it ruptured and discharged thick pus); (2) two collections of tuberculous fluid in the thigh, one anteriorly placed and the other posteriorly, and (3) an abscess in the lower and anterior third of the thigh from an osteomyelitis of the upper third of the femur.

Two tumors were in the bursæ of the knee joint; one proved to be a large bursa (22 cm. in diameter) beneath the tendons of

the semimembranosus and semitendinosus, containing thick, fibrinous clots and clear, serous fluid; the other was clinically considered a calcified semimembranosus bursa.

Prepatellar bursitis occurred three times in the series. One bursa contained multiple areas of whitish material resembling bismuth, and was surgically considered tuberculosis; one was clinically diagnosed tuberculosis because of a co-existent tuberculosis of the ankle, and the third at operation proved to be simple bursitis. There were four tumors in the soft tissues of the neck: two with evidence of calcification proved at operation to be calcified tuberculous glands, a third homogeneous shadow, in front of the hyoid bone, proved to be a branchial cyst, and a diffusely mottled shadow under the hyoid bone, a cartilaginous tumor of the larynx. The foreign bodies in an inflammatory cyst, which followed a fall on the elbow, were found at operation to be two small pebbles. The recurring cartilaginous tumor of the arm had a history of nine years' gradual growth, and at operation had proved to be a tumor in the biceps muscle containing irregularly placed small kernels of cartilage and bone. This tumor had recurred one month after operation. In one case tuberculous synovitis occurred in the wrist, and in one, in the ankle joint. The tendon ganglion was in the soft tissues over the styloid process of the radius. Three small tumors in the soft tissues of the back were interesting; one, a papillary epithelioma, lay directly over the spine, but proved at operation to have no connection with the skin or the spinal canal; the second, a small pedunculated tumor, lay over the left side of the fifth lumbar vertebra and, until closely examined, suggested a lesion of the vertebra, while the third closely simulated a stone in the kidney or in the gall bladder.

Fig. 3. Lymphangioma involving the right leg.

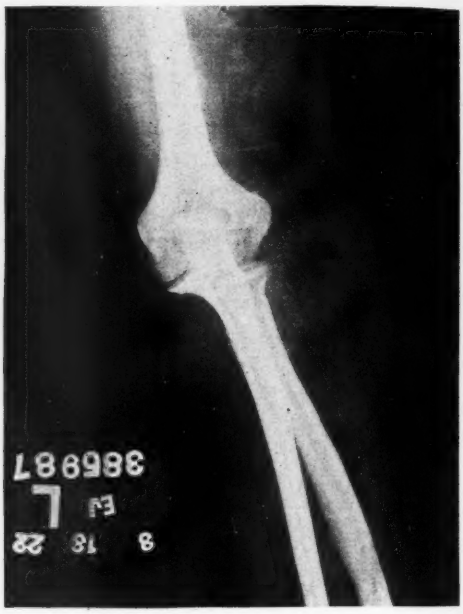

Fig. 4. Multiple fibromatosis.

MALIGNANT TUMORS

Thirty-one of the forty-one malignant tumors were sarcomas; all but seven of these were operated on; of these, one was in the gluteal region, three were in the thigh, one was in the arm, and two in the forearm. There were two mixed-cell sarcomas, one in the thigh, and one in the forearm; two spindle-cell sarcomas, one in the axilla, and one in the supraclavicular region; one melanotic sarcoma, in the thigh; and eight fibro-

sarcomas, one in the buttock, three in the thigh, two in the leg and two in the forearm. One fibro-osteo-sarcoma involved the upper half of the arm; one chondrosarcoma, the sole of the foot; one angiosarcoma, the thigh, and one liposarcoma, the upper half of the leg. The latter tumor had been observed periodically at the Clinic for several years, and two years before, had been reported as a degenerating lipoma. There were seven myxosarcomas; three in the thigh, three in the tissues around the knee joint, and one in the supraclavicular region.

Epitheliomas occurred in four cases of the series; two were in the thigh, one was an epitheliomatous ulcer in the leg, and one, an epithelioma which had destroyed a portion of the lower jaw—this latter appeared as a large soft-tissue tumor below the jaw. There were three melano-epitheliomas: one in the foot (this patient had metastasis to the lungs), one in the leg, and one in the distal portion of the thumb. There was one non-melanotic epithelioma of the distal end of the great toe, and two soft-tissue tumors in the neck were metastatic epitheliomas from the lip.

ROENTGENOLOGIC CHARACTERISTICS

The lipomas appeared as definitely circumscribed shadows clearly demarcated from the surrounding tissues, with a central area of decreased density, and a peripheral area of increased density (Fig. 1). Both areas varied in extent and in density in the individual tumors. One of the series showed multiple calcareous deposits in the tumor. The fibro-lipomas were less clearly demarcated from the surrounding tissues; none of them revealed the variation in density of the center and periphery seen in the lipomas; two were homogeneous throughout, and the remainder exhibited a wavy mottling, due no doubt to the increased connective tissue. In one of this group were extensive deposits of calcium (Fig. 2). In the fibro-chondro-lipoma the shadow was similar to that of the fibro-lipoma, with the addition of a slight mottling due to the cartilage.

The two hemangiomas varied markedly in the roentgenogram; one appeared as a small, sharply circumscribed, homogeneous shadow, while the other, which was thrombosed, was not sharply circumscribed, and presented a wavy mottling throughout, similar to that of the fibro-lipoma.

Fig. 5. Elephantiasis.

The lymphangioma was seen as a thick-walled cyst overlying the muscles; in the wall were fine, radiating, horizontal lines, similar to the sun-burst rays of a periosteal sarcoma (Fig. 3). The myxoma was a recurring tumor and an amputation of one toe had been performed; the tumor appeared as a homogeneous, definitely demarcated shadow in the sole of the foot. The fibro-osteoma presented a transparent center with a periphery of increased density that had a "woven" appearance very suggestive of a bird's nest. The xanthoma was shown as a small homogeneous shadow with a center of slightly increased density. The osteochondromas had the typical cauliflower appearance of this tumor, and the chondroma, the flat, undifferentiated shadow of the pure cartilaginous growth. Two of the arterial aneurysms were indistinguishable

from the soft tissue which contained them; the third was clearly demarcated by the calcification of its walls, and throughout the periphery of the venous aneurysm were "splashes" of calcification.

In the sebaceous cyst were a central area of dense calcification, and a peripheral ring

Fig. 6. Fibrosarcoma of the arm.

of soft-tissue tumefaction. Whatever connection they may have pathologically, the roentgenograms of neurofibromatosis, epithelial hyperplasia and elephantiasis differ materially. Neurofibromatosis casts a shadow suggesting multiple small nodular areas rich in connective tissue (Fig. 4); in the epithelial hyperplasia there is a marked increase in the density of these areas, while that of elephantiasis resembles closely the picture of lymphangioma (Fig. 5), the horizontal striæ in the capsule being more or less apparent, according to the size of the growth.

There was nothing definitely characteristic in the remainder of the benign tumors other than I have described in the clinical and pathologic data.

Almost without exception the malignant tumors present homogeneous shadows and the tendency to demarcation is less frequent; they appear in general to invade the tissues more than the benign tumors, but sharp definition of their outlines is seen in fibrosarcomas, angiosarcomas and in the epitheliomas (Fig. 6). The latter, and particularly the melano-epitheliomas, show very marked density of their shadows.

CONCLUSIONS

There is no definite distinction between the benign and the malignant tumors. While the lipomas are distinctive, one sees sarcomas with many of the characteristics of the lipoma. Many fibrosarcomas have much in common with the fibro-lipomas. Fibrosarcomas may closely simulate neurofibromatosis. In many cases, the type can be determined definitely only by the pathologist. The study has been of value in classifying the surgical findings and establishing certain fundamental points in the differential diagnosis of soft-tissue tumors.

ADVANCED TROUBLE SHOOTING [1]

"Phasing In" a Disk

By C. B. HORSLEY, Pittsburgh, Pa.

THERE are some doctors who take pride in the fact that they can and do make most of the repairs necessary for the upkeep of their X-ray apparatus. These doctors make it almost a hobby to ascertain the reason for a breakdown, and to repair the defect properly. They take almost the same pleasure in doing this that they would take in going eighteen holes of golf, or overhauling their automobile.

There are other doctors who, though they do not seem to possess quite the same mechanical inclination, are, nevertheless, on account of their out-of-the-way location, almost compelled to do most of their own trouble shooting, or in the case of a breakdown, submit to considerable expense and delay in order to secure a competent service man. It is for these two classes of doctors that this is written.

For those roentgenologists who have neither the time nor the inclination to attempt the repair of their outfits, and to whom a service man is more or less accessible, these articles will prove of little interest.

At the outset it should be stated that the average electrician knows very little concerning most X-ray apparatus, and, to give him due credit, he generally admits this fact with due servility.

One of the really simple procedures, the very name of which would generally suffice to completely "scare off" both the electrician and the doctor in charge, is the procedure of "phasing in" a disk. There are two reasons why this might be necessary. On certain makes of machines it is possible for the disk to slip out of phase, should the hub bolts become loose, and, in case the old disk has broken, or "broken down," and a new one has been ordered, this new disk must be phased in upon mounting.

To phase in a disk, first mount it securely on the shaft of the synchronous motor. There will always be some method of locking the disk temporarily without permanently fastening it in this position. Some

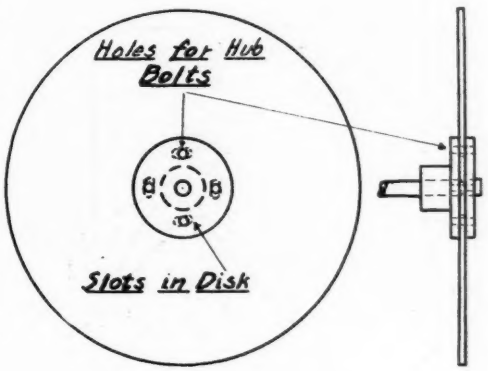

Figure 1

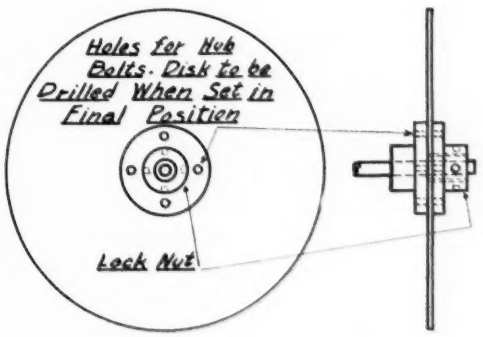

Figure 2

[1] It is hoped to follow this paper by others of a similar practical and helpful nature.

types of disks have slots through which the hub bolts project and which allow the disk to be shifted (Fig. 1), while on other machines the disk is clamped by a lock nut, and when it is finally set in correct position holes must be drilled through the disk for the hub bolts (Fig. 2).

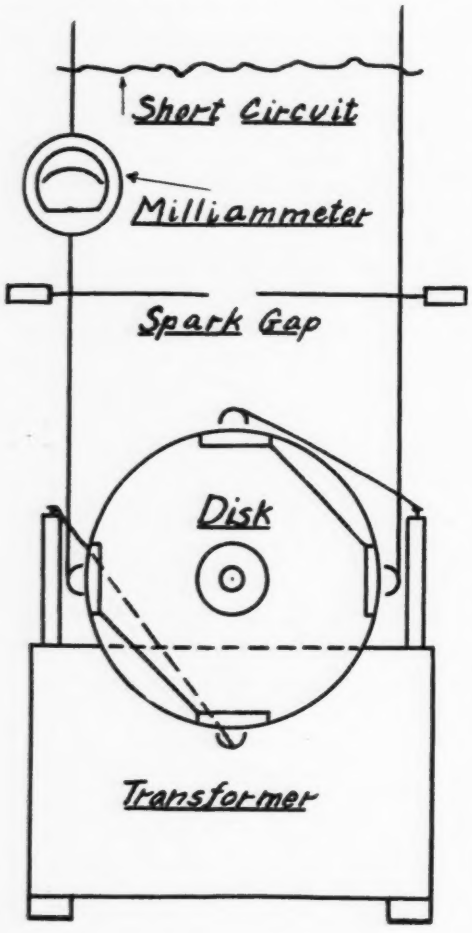

Figure 3

After securing the disk in place, reduce the secondary voltage as low as possible, that is, set the auto-transformer on its lowest step and introduce all available resistance into the primary circuit. Next, short-circuit the secondary, leaving the milliammeter in the circuit (Fig. 3). Make a mark on the part of the hub that is fastened to the motor shaft, and extend this mark on to the disk. Start the motor, cut in the transformer, and take the reading of the milliammeter. If the milliammeter indicates that the current is reverse, shift the disk ninety degrees and start again. After the meter indicates the current to be in the right direction, shift the disk either to the right or left of the original mark, secure it in place, and again start up and take the reading of the milliammeter. Of course, conditions vary, but about as good an arbitrary rule as can be made might be to shift the disk three-quarters of an inch at the hub as long as the meter reads below two milliamperes; as the readings increase, decrease the length of each shift. If after the first shift the meter reads less than it read at the original setting, you will know that the disk should be shifted in the opposite direction.

When the final mark has been reached the disk can generally be moved slightly without appreciably affecting the reading of the milliammeter. The disk should be permanently locked at approximately the center of this peak position.

X-RAY TREATMENT OF HYPERTHYROIDISM AND TOXIC GOITER [1]

By C. AUGUSTUS SIMPSON, M.D., WASHINGTON, D. C.

SINCE the advent of higher voltage X-ray machines and larger tubes and the enthusiasm with which radiologists have attacked problems of malignancy, we are apt to lose interest in some of the past accomplishments of the roentgen ray. Hyperthyroidism is still a very live question which should be the subject of free discussions in our Society at regular intervals. It is due to the aggressiveness of the radiotherapeutist, in the face of difficulties and criticism from even some radiologists, that surgery has been placed on the defense in toxic goiter. In 1914 and 1915, two of my papers were most unmercifully criticized by two prominent radiologists, while the rest of our local Society seemed to gaze on my execution with pity. Such fatalities are, no doubt, but an example of what we all experienced six to ten years ago in developing the subject. It was all the harder for the average radiologist, who occupied a position of inferiority in a hospital, and even to-day many backward institutions manage to allow patients with toxic goiter to go to the operating room without either X-ray or rest.

There is very little that is new in the treatment of hyperthyroidism from the standpoint of the radiotherapeutist, but the necessity of co-ordinating and standardizing our technic is more important than ever. I believe that every radiotherapeutist of America who uses 2 to 4 mm. of aluminum, giving approximately one-half a skin dose of ray, and repeats the exposures over the two lobes of the thyroid and over the thymus gland area every three or four weeks, is relieving the symptoms of approximately 75 per cent of his cases of hyperthyroidism. This, I believe, is the average technic of all who have treated any great number of these patients. However, an average will not do, and we are severely criticized for not developing a standard technic, giving a definite amount of ray, which will be adhered to by all. A wonderful paper given out a few years since, spoke of the dose of ray administered in a certain institution as varying 25 per cent. This was hit upon by many physicians as a proof that we could not regulate the amount of X-ray. When two equally reputable physicians use different thicknesses of aluminum for a filter it is cited as positive evidence that we can not agree on the correct dosage in toxic goiter, and when we can, there is no certainty that the dosage is accurate. I have had to meet this criticism in open medical meetings, and I suppose you all have had to deal with the same. So much has been written about the dosage of X-ray, and the profession at large has become so "fed up on" the misfortunes of faulty technics, that it seems extremely important that this misconception should be corrected at once. Certainly, my technic to-day varies 100 per cent from that which I employed ten years ago, but my technic and treatments to-day do not have a 25 per cent biological variation, or anything like that amount. When we can successfully produce a satisfactory and temporary alopecia in case after case of tinea with an unfiltered and exposed tube, to say that our dosage varies 25 per cent with a filtered ray gives our colleagues an entirely erroneous impression of what we do.

The surgeons to-day, after forty years' work on exophthalmic goiter, are still unable to agree upon how much ligation to do or how much of the gland to excise. Do not let this be said of us. There is a satisfactory non-dangerous technic used in irradiating toxic goiters to-day. Let us get together and agree upon it.

My experience leads me to believe that many of the surgical failures are due to a persistent thymus gland. In six instances

[1] Read before the Radiological Society of North America, at Chicago, June, 1924.

in my series I have confined the ray to the thymus region alone and secured as great relief of all symptoms—including acute mania in two of them—as I have ever witnessed. One of these patients had been operated on three times, while another had part of the thyroid removed in one operation.

On account of the changes in classification in the past ten years, I am unable to state the percentage of toxic adenoma in my series of two hundred cases. I can say, however, that in my experience the toxicity of this type of lesion is apparently as readily controlled as in simple hyperthyroidism. Pressure symptoms are relieved, but it is the exception in the chronic cases to have the tumor disappear. So long as there are toxic symptoms present, somewhere in that particular gland is to be found the pathology of hyperthyroidism. X-ray will have its atrophic action on this pathology, and it does not matter if the clinical type of goiter be cystic or colloid.

ETIOLOGY

In a majority of my patients, over 60 per cent, the toxic symptoms were associated either with beginning menstruation, menopause or pregnancy. Focal infections in the teeth and tonsils did not play such an important part in the origin of the symptoms as some change in the ovaries. Also, in 32 per cent of my cases the toxicity continued unabated after the tonsils were removed and the mouth put in good condition by extractions and amputations of the tooth roots.

SYMPTOMS

In recent years we have naturally relied almost exclusively on a plus metabolism rate, not only to institute treatment but to gauge the progress of the improvement. A metabolism instrument should be a most important part of the office equipment of every radiologist. I believe that every physician who practices internal medicine should have a metabolism machine. It keeps him in touch with his patients; it allows him to give valuable advice to them in troublesome family contentions—a large contributing factor in many cases of hyperthyroidism—and it also allows him to take apart and visualize the improvement in his patients as the X-ray treatments are given. If you have any skeptics near, have them install a metabolism outfit and let them see your results with their own eyes. They will all become "boosters" for the X-ray.

Considerable interest has, of late, been manifest in a serum test, the "Kottmann Test for Thyroid Function." The principle of the test is based on a photo-sensitive reaction similar to that used in commercial photography in the making of the photo-sensitive film. Instead of albumin or gelatin mixed with silver salts, we use the patient's serum mixed with a silver salt, and after exposure to light and developing with a developer, as in the case of the photographic film, we get a darkening in color. This darkening takes place very quickly with a normal serum, but if there is hyperactivity of the thyroid there results a marked retarding of the developing of the color. As far as the patient is concerned, this is a very simple test. The same technic is used as in taking blood for a Wassermann. For the laboratory man the test is simple, but requires accuracy in weighing out chemicals and exactness in measuring out the solutions. An error of one one-hundredth of a cubic centimeter in measuring solutions may spoil the test. The test is carried out as follows: To 1 c.c. of fresh clear serum is added 0.25 c.c. of 0.5 per cent potassium iodide and 0.3 c.c. of 0.5 per cent silver nitrate. After gentle mixing the tube is exposed for five minutes to a 500-watt Mazda at 25 cm. distance. (We found that correct results could be obtained from a ten-minute exposure to a 50-watt lamp at 10 cm. distance.) Next, 0.5 c.c. of 0.25 per cent hydrochinon solution is added. In case of a normal serum, darkening takes place and is complete in one to three minutes. With a serum from a hyperthyroid case, darkening is delayed to five or ten minutes or longer. All re-

agents for this test must be made up fresh each time the test is run and the serum must be fresh. My associate, Dr. Leffler, has run some sixteen tests on hyperthyroid cases and most of them have checked fairly close with the symptoms. We believe that this test will, with some refinements, prove of value to the X-ray laboratory; also it is not so time-consuming as the metabolism test. Some results follow:

PATIENT	KOTTMNNN TEST	BASAL METABOLISM
Mrs. P.	15 min. (rtd.)	Plus 19
Miss R.	3 min. (nor.) No signs of hyperthyroid at time of test	Plus 19 (Several weeks previous to Kottmann)
Mrs. M.	15 min. (rtd.)	Not done
Mrs. H.	12 min. (rtd.)	—9
Miss T.	4 min. (nor.)	—4 (nor.)
Miss H.	10 min. (rtd.)	Not done
Miss T. (definite hyper.)	5 min. (rtd.)	Not done
Miss Q.	9 min. (rtd.)	Plus 22
Miss V.	10 min. (rtd.)	Plus 32
Miss D.	10 min. (rtd.)	(?)

In addition to the tachycardia, tremor and other classical symptoms, I should like to call your attention to four prominent points in the diagnosis, most of which are not mentioned in Osler and other works on general medicine. A standard work like Strümpell, for instance, states that there is nothing abnormal about the pupils. In at least 75 per cent of my patients I have found widely dilated pupils, and a consequent irritability to light. I am indebted to Dr. E. D. Seibert, of Washington, for an illumination test that is valuable in hyperthyroidism. A pocket light directed into the eye from an oblique angle will not cause the pupil to contract in these cases as it will in the usual dilated pupil. We believe that dilated pupils in hyperthyroidism are almost constant and are due to a toxin acting on the cervical sympathetics and not due to pressure, as it is present many times in the absence of a tumor.

Another frequent and easily explained symptom is air hunger and a sense of suffocation, when the patient feels as if all the windows in the room were closed. These patients are almost invariably "fresh-air fiends." A third symptom, and one which the patient with hyperthyroidism as well as her family finds difficult to understand, is an unusually large appetite, an enormous appetite, greater than when the patient was robust and in perfect health, but now associated with intense nervousness and loss of weight. I find a large appetite quite as frequent as a loss of weight. Many of my patients find it hard to interpret the meaning of this large and wholesome appetite, associated with progressive and at times rapid loss of weight. A fourth symptom is perspiring hands. Often a handshake and a look into the patient's eyes will make a diagnosis which will later be confirmed by the metabolism test. Naturally this symptom is but a part of the free and general sweating of the entire body and accounts for the greater electrical conductivity of the skin, but on the palms it is conspicuously copious and troublesome.

I have never agreed with a recent article that, unless improvement begins in one month, which almost invariably means one treatment, surgery may be resorted to. In the majority of my patients I have insisted that at least three full treatments, or seven to nine weeks, elapse before we should consider the X-ray a failure. We are constantly beset by our surgical friends and the patients to hurry the treatments and results. To do so will many times mark our one treatment as a failure and drive the patient into a needless operation, which in two instances in my series led to the death of the patient on the operating table. In addition to the criticism of dosage which has been leveled at us, the greatest censure of X-ray treatments that I have encountered is the tardiness of results. I will agree that waiting this length of time has been a

hardship on both patient and family, although I do not know of an instance where the delay has been fatal. At the same time, we are criticized for the delay which might allow cardiovascular lesions to develop which may cripple the patient. To neutralize this censure, I believe that Lugol's Solution internally will be the greatest boon to roentgen-ray treatment of hyperthyroidism that we have had in five years. I have had six patients in whom I have been able to control all of the symptoms, with the exception of exophthalmus in three cases, by giving five drops of Lugol's Solution three times a day. This improvement began on an average of four days after the iodin compound was prescribed, and its effects were marked and constant in every patient treated. It allows one to proceed with the treatment of the thyroid gland by X-ray with security and without the danger of myocardial or other lesions developing while waiting for the well-known and proven atrophying effect of the ray on the secreting epithelium of the gland. I am positive that it will be the means of our tiding many patients over the stormy early days of X-ray treatments and preventing operations on the more impatient ones.

DOSAGE

In treating most of my early patients ten or twelve years ago, when we employed gas tubes with all their uncertainties, I made the mistake of giving doses too large and repeating them every ten days or two weeks. This I have long since corrected and I have also increased the filter from one to three millimeters of aluminum in addition to a layer of chamois skin between the filters and the irradiated surface. My technic for the past six years has been 7-inch gap, 5 ma., 3 millimeters of aluminum, 10-inch distance, and time, six minutes. This dose is given through an oval-shaped hole in lead rubber (2½ by 3½ inches) over each lobe of the thyroid. Over the thymus I employ a portal 3 by 4 inches. The 4-inch edge of the portal is on a line with the suprasternal notch. These treatments are never given oftener than every three weeks. The thymus region I treat only at alternate periods, or once in six weeks. As the symptoms subside, I lengthen the thyroid treatments to every four weeks.

My experience in irradiating the thymus glands of a series of rabbits and guinea pigs, in 1916, demonstrated how quickly the gland is atrophied by the X-ray. It is much more radio-sensitive than the thyroid, and does not require as much ray for one to get a result. In addition to this, there is a triangular area over the upper chest of most women who wear V-neck waists that is extremely sensitive to all irritants, including X-ray. Even the static from the apparatus produces a redness here that may come on before the patient leaves the table and disappears the next day without leaving any trace. This triangular area,—base upwards,—is so sensitive that it is frequently irritated by the wind and very slight exposures to sunlight. It is more sensitive to X-ray than the thyroid area. The secondary rays from the filters should be guarded against here by interposing a layer of leather between the aluminum and the skin. Extreme care is to be exercised not to get the least amount of skin reaction over either of these areas, for it will invariably produce a telangiectasia which will annoy you in later years. In addition to the natural lowered resistance of these flexor surfaces, I have demonstrated time and again that an ice bag applied to the neck for two hours will bring out a redness over the irradiated areas that will not be seen in other places that the bag touches. I found, some eight years ago, that heavy pressure and half-hour exposures with a Kromayer Lamp, using the blue lens, will often thrombose these small dilated vessels and produce a cure. I have also known fulguration and endothermy to produce keloids when used in this area.

My results in over two hundred cases of toxic goiter have, no doubt, been approximately the same as those obtained by most of you. Seventy per cent of my patients regained their normal weight, had a pulse

below eighty-five, were no longer nervous and were symptomatically well at the end of their treatments (which averaged six). The exophthalmus and the tumor were always reduced in the early cases, but remnants of both remained if the lesion had existed one year or longer. I never promise my patients to eliminate these two symptoms entirely, although by palpating the gland in the hypertrophied cases one can detect a sense of resistance and hardening of the lobes very often three weeks after the first X-ray treatment. The pressure symptoms in the neck and eyes begin to subside at this time.

As to the permanency of results, I believe it compares very well with surgery and many of my cures are of more than ten years' duration. A goodly proportion, more than 8 per cent, of my patients had from one to three operations, with a return of all of the symptoms, including the tumor. Irradiating the thymus alone in some of these surgical failures will give brilliant results. The truth of the matter is that the surgeons probably get our failures and operate on them, at times with a permanent cure, while those of the surgeons' failures which escape the undertakers come to us, and we, in a majority of instances, effect a cure with X-ray.

DISCUSSION

DR. J. W. HUNTER, JR. (Norfolk, Virginia): My experience with the work is certainly less than that of Dr. Simpson. I have always felt that the thyroid cases that drift into our hands (on the Atlantic seaboard) are those upon whom the surgeons do not care to operate, or those upon whom they have failed. Unfortunately, also, most of my cases have been of the chronic type and the question was not one of seven or nine treatments, but, to borrow a biblical expression, almost seventy times seven. That, of course, is exaggerated. I have had some very brilliant results. In one case, that of a woman in the fifties with exophthalmic goiter, the patient was treated over a long interval with a marked result that was greatly intensified by the subsequent removal of several abscessed teeth and her tonsils. Her present condition is all that can be desired.

Dr. Simpson has suggested a stereotyped treatment. Personally, I can not approve of this. There should be just as much leeway in the use of roentgen rays as of drugs. No one would legislate doses of strychnine or quinine. They have to be varied according to the case and the patient.

Elephantiasis in arm.—Elephantiasis of the upper extremity is rare. In this case of congenital blocking of the lymph channels, the axillary channels are more affected than those on the outer side. The bone changes show distinct atrophy, as well as proliferative changes. There are lime salt deposits throughout the soft tissues, probably due to demineralization of the bone and redeposition of the calcium salts in the soft tissues along the lymphatics.

Patient is a man, age 23, and enlargement of the arm began when about eight or nine months old.

W. W. WATKINS, M.D.

Roentgen Findings in a Case of Congenital Obstruction of the Median Basilic Vein and the Deep Axillary Lymph Channels. F. E. Diemer and Frank E. Butler. *Northwest Med., March, 1924, p. 125.*

THE DIFFERENTIAL DIAGNOSIS OF PERIOSTEAL BONE LESIONS

By JOSEPH COLT BLOODGOOD, M.D., BALTIMORE

WHEN we palpate the involved bone in what I term a periosteal lesion, we feel something outside the shaft and it does not feel like a bone shell or a circumscribed expanding tumor, as in the central tumor when the bone is destroyed. This palpable periosteal mass may be spindle in shape, and it is important to record here that the older view that such a spindle-shaped, palpable tumor indicated malignancy is incorrect.

The first differentiation, then, between a central and a periosteal bone lesion is by palpation, and with the rarest exception, by palpation alone should one make the differential diagnosis.

Remember, most periosteal lesions, both benign and malignant, attack the shaft rather than the epiphysis, while central lesions are almost equally divided between the shaft and the epiphysis. An age under fifteen in the central lesion is helpful in excluding malignancy, but not so in the periosteal lesion.

No one has attempted recently to classify, on palpation, periosteal lesions. Before the days of X-rays the older surgeons were very expert in palpation, and the older books have clear descriptions, but these surgeons saw the lesions so late, and their ability to differentiate, even after amputation, between the benign and malignant was so faulty, that unfortunately these remarkable descriptions of the palpable periosteal mass were not helpful.

When one can palpate a periosteal lesion as bone just as distinctly as one's shin bone, the chances are that it is not sarcoma, and when it feels irregular like a coral and one can feel a distinct pedicle, an exostosis may be diagnosed. The great difficulty in differentiating between the benign and malignant in periosteal lesions, both on palpation and in the radiograph, is due to the positive knowledge that excessive bone formation may be present both in sarcoma and in inflammatory lesions. An absence of bone formation is also observed in both the benign and malignant lesions.

What are the periosteal lesions of benign character which, on palpation and in the X-ray, suggest the possibility of periosteal sarcoma?

Fracture. When a fracture heals the periosteal bone gives rise to a spindle-shaped palpable tumor, and in the early stages, in the radiograph, the periosteal shadow is not unlike a form of periosteal sarcoma with bone formation in the periosteal tumor. As a matter of fact, I have had three X-rays of fractures referred to me with the diagnosis of periosteal sarcoma. One involved the phalanx of a finger and two the metacarpal bones of the foot. In all three one could see the fracture without displacement. *It is very unusual to see fracture in periosteal sarcoma, except in a late stage, when diagnosis presents no difficulties.* In these three cases of fracture sent to me with the diagnosis of sarcoma, I could observe in all the marrow shadow "pin callus" of new bone formation of less diameter than the periosteal shadow. Examining the radiographs of periosteal sarcoma with fracture, this marrow shadow is absent.

Fracture in periosteal sarcoma with periosteal bone formation is very rare, except after a severe injury which might break the normal bone.

Fracture of Beak-shaped Process of the Tibia (Schlatter-Osgood Disease). On a number of occasions radiographs have been referred to me with the diagnosis of sarcoma which proved to be injuries to this epiphysis of the tibia, and, on the other hand, in one instance, the interpretation was fracture of the beak-shaped process in a lesion typical, clinically and in the radiograph, of *sclerosing sarcoma.* The best way to learn to differentiate them is to study the radiograph of the upper end of the tibia in the lateral view in young children and adolescents. Then, when the patient comes to you with the history of a bump over the tubercle of the tibia and a painful swelling there, always take a lateral view of both legs for comparison. The

X-ray shadow of the normal beak-shaped process in the stage of ossification, with or without the history of an injury, and with and without fracture, is not unlike, at first sight, periosteal sarcoma, but the shadow of the bone beneath, both the shaft and epiphysis, is normal. In the one case sent to me with the diagnosis of fracture of the beak-shaped process, there was an irregularity in the shadow of the process, but the first observer had failed to see the change in the shadow of the upper end of the tibia. There was a cloudiness of this irregular and mottled area which is only seen in sclerosing sarcoma. This diagnosis was corroborated by the specimen obtained by amputation.

Tuberculosis. The great majority of cases of tuberculosis involve the epiphysis near a joint. The destructive areas are often multiple in one bone and very frequently involve both bones of the joint. The involvement of two or more bones in the neighborhood of a joint and of multiple areas practically excludes sarcoma. When the tuberculosis involves small joints of the hand and the fingers there is very apt to be a reactive ossifying periostitis of one of the bones contiguous to the joint involved, and this radiograph of the shaft alone might suggest sarcoma.

But when I review our great mass of material on tuberculosis of bones and joints, with the greatest rarity is there anything in the clinical picture or radiograph which would even suggest malignancy. In the *Journal of Radiology* for 1920, four years ago, I reported three cases, and I do not remember a single example since. Among the sarcomas registered with Dr. Codman of Boston, I do not recollect an example of tuberculosis, although a large number of other benign lesions were registered as sarcoma.

Syphilitic Periostitis. The first question is: Is this a periostitis, an osteitis, or an osteomyelitis? As far as my personal observations go, there is always a periosteal lesion, granulation tissue between the periosteum and the bone, usually with bone formation. In syphilitic periostitis the cortical layer of bone shows some bone destruction. Beyond this, the cases vary. There are some in which the X-ray shows a normal marrow, while others suggest marrow involvement with pictures not unlike ordinary osteomyelitis.

Very many cases of syphilitic periostitis, with or without involvement of the marrow of the shaft, give the clinical picture of sarcoma, palpate like sarcoma, and in the radiograph are difficult to differentiate from sarcoma, and the undisputed fact remains that limbs have been amputated on the diagnosis of sarcoma, when the lesion really was syphilitic periostitis.

Exploration for biopsy does not always make the diagnosis easier, because the inflammatory tissue of syphilis resembles somewhat lymphosarcoma.

This known difficulty in diagnosis makes it imperative that in every bone lesion there should be a Wassermann test, and with the rarest exceptions, when the Wassermann is negative, all periosteal bone lesions should be given one or more intravenous injections of salvarsan or its equivalents.

I now have records of at least six periosteal bone lesions with negative Wassermanns in which the bone lesion cleared up under intravenous salvarsan. On the whole, when one studies many cases of syphilitic periostitis, the diagnosis is made simple by multiple bone lesions, by other positive signs of syphilis, or by a positive Wassermann reaction. When there is but a single bone lesion and nothing else, the blood reaction is usually positive, and when we critically study the radiographs of numerous examples of proved syphilitic periostitis, we begin to find that in the radiograph alone syphilitic periostitis rarely suggests periosteal sarcoma. The frequency of the mistakes in the past was due to inexperience, and the infrequency of the opportunity to see such cases.

Then, again, one must remember that individuals with periosteal sarcoma may have a Wassermann reaction, but here salvarsan has no effect upon the bone lesion, while in syphilis within ten days after medication you as well as the patient will observe improvement.

DEPARTMENT OF RADIODONTIA

UNDER THE SUPERVISION OF BOYD S. GARDNER, D.D.S.,
ROCHESTER, MINNESOTA

A METHOD OF MOUNTING RADIOGRAPHS, AND TESTS FOR VITALITY

By R. C. BOYD, D.D.S., DENVER, COLORADO

IT has been my practice to make extra-oral films in cases in which the intra-oral films indicated impactions, cysts, fractures, and so forth, but when these, together with a complete mount of small films, were taken to the operating room to be studied while operative proceedings were in progress, more or less confusion resulted, as it was difficult to place the two extra-oral films and the card on which the intra-oral films were mounted in a position which would enable the operator to see them all readily. This generally resulted in the handling of the films, thereby establishing at least one break in the otherwise perfect chain of asepsis.

As compared with the method of mounting between two pieces of 8 by 10 glass, this mount, I believe, has many advantages: (1) it is light; (2) it is non-breakable; (3) it requires very little space for filing; (4) films stay in place in the mount, light being transmitted through films only; (5) it allows a better opportunity to observe detail, and (6) it is more pleasing to the eye.

As compared with the method of mounting on 8 by 10 cardboard, the films stay in place better, the surgeon has in view a record of the complete diagnosis, tests, and other markings indicating pathologic lesions, without having to handle the films while operating. This point alone is of sufficient value to merit consideration.

Usually each installation requires a particular technic. However, I use for the extra-oral films: 5-inch spark gap, 30 milliamperes, 20-inch focal distance, and a 6-second, or 180 milliampere second exposure.

The mount is made of an 8 by 10 duplitized superspeed film, with a triple exposure, one each for the extra-orals, and a third to blacken the film around the circles and radiograph on the name, and the "right" and "left" letters.

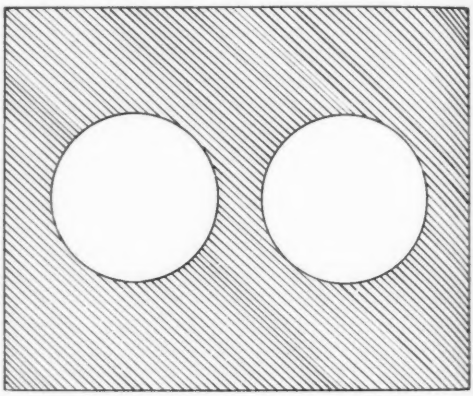

Fig. 1

From a piece of lead 8 by 10 by 1/16 inches, two circles, 3.5 inches in diameter, are cut (the disc being carefully preserved for a purpose which I will explain later), spacing 1 inch from the border on each side, and a like space in the center between the two circles. Before making exposures the inside of the circle on the film holder is traced with a lead pencil so that one may know where to place the 3.5 inch discs to protect other exposures.

The 8 by 10 piece of lead (Fig. 1) is placed on the holder containing the film, one circle covered with other strips of lead, the patient's head being placed over the uncovered circle, and the first exposure made (Fig. 2). The exposed side of the

film is covered with the strips of lead, the other side of the head is placed over the unexposed side of the film, and the second exposure made. The 3.5 inch discs of lead cut from the circles are placed on the film

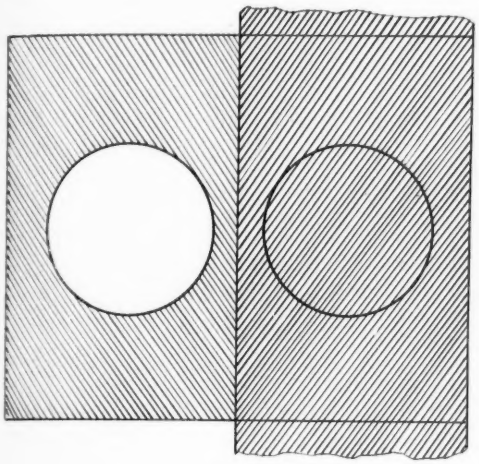

Fig. 2

holder to correspond with tracings of the lead pencil (Fig. 3), the name at a convenient location, and the "right" and "left" lead letters in place, and then the third exposure is made. The plate is developed in the usual manner by time or appearance, as preferred.

Intra-oral films are made in the usual manner, being about twelve in number. When developed and dry, the films are carried to mounting table, and "layed out," as they are to be placed on the mount. The mount, being dry, is cut out with standard dies to meet the required number of intra-oral films. The films are then easily and quickly mounted, and are bound with passe partout tape, which reduces the flexibility, and adds quite materially to the attractiveness of the finished mount.

TESTS FOR VITALITY

I believe that a test for vitality is second in importance only to the radiograph, and, indeed, in some cases the test for vitality is equally as valuable as the radiograph. Raper, quoting Johnson, says, "A single instance, illustrative of many others which might be mentioned, will serve to prove the present contention. A patient had pain in

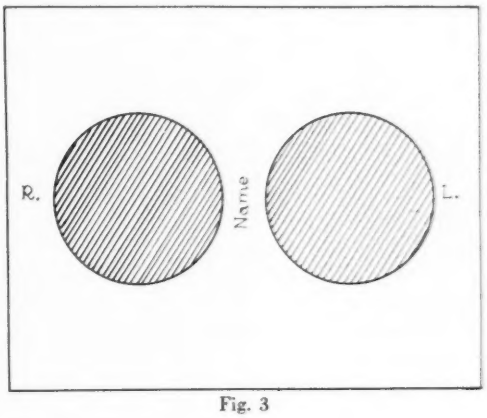

Fig. 3

the region of the upper left cuspid. This tooth was banded as the middle pier to a bridge. A radiograph was made of the region, and the verdict of the radiographer was that there was an extensive abscess cavity around the cuspid with the bone all absorbed. His remark was: 'If you cut the band the cuspid will drop out. Nothing holds it in place but the band.' The band was cut and the cuspid was found perfectly firm; the thing that nearly dropped out was the bridge, the cuspid having been its chief support. Thinking, from the evidence of the radiograph, that there must at least be an abscess on the cuspid, it was drilled into, only to find a live pulp. Here, with the best intentions, a wrong was done the patient, on the evidence of the X-ray, and it is probably not an isolated case."

In this case the test for vitality would have been of inestimable value. Without doubt, the cuspid would have responded normally vital, after which, I doubt that drilling would have been warranted. Therefore, I believe all teeth should be tested if a diagnosis is made of the complete denture, the only exception being in the case

of extremely nervous persons who cannot endure even the slight pain caused by the testing. Such instances, fortunately, are rare.

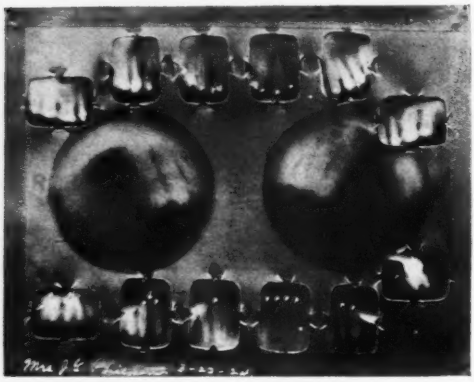

Fig. 4

I wish to emphasize the importance of careful testing for vitality. Every possible means should be exhausted for ascertaining the exact condition so that an innocent pulp may not be exposed and sacrificed. A recent experience will serve as a constant reminder to me to exercise greater care in pronouncing a tooth pulpless, or otherwise. A woman came to my office with a badly broken down upper right bicuspid, and although I tested it with 1,000 volts of electricity, I found no evidence of vitality. On excavation, the tooth was found to be vital.

A letter is marked on the tooth crown in the radiograph to indicate positive or negative to a vitality test; thus: P, meaning positive to test, or vital, and N, negative or pulpless.

Technic of divided doses.—In the discussion Dr. Martin explained that the term "fractional" probably should have been "divided," since it refers not to the amount of ray given but to the technic.

Interrupterless transformers are used, and regular treatment stands, with cones, with openings of varying sizes. When the bottom of the cone is in direct contact with skin, the target skin distance is 10 inches. In superficial skin malignancies, his technic is a 5-inch gap, at 5 ma., for five to ten minutes, at 10-inch distance, filtered through 0.5 mm. aluminum. The 5-minute exposure is one erythema dose, estimated by the Witherbee and Remer technic, the 10-minute exposure being two erythema doses. The exposure is repeated every other day for from four to six treatments if growth is small, and eight to ten treatments if growth is thick. At the end of six days, when the fourth treatment is given, the effects of the irradiation will begin to show, and reasonably accurate conclusions as to the necessity for further treatment can be drawn.

For the gland-bearing area, higher voltage is used, the following factors being the rule: 8-inch gap, 5 milliamperes, 10 minutes at a 10-inch target skin distance, with 4 mm. of aluminum, which gives 40/45 of an erythema dose. This can be repeated in three weeks, if desired, and if no marked reaction occurs. More recently a filter of 0.5 mm. of copper, with 140 p.k.v., 6 ma., at 12-inch distance using 60-minute exposure has been employed with good results. The glands under the jaw will swell temporarily following this dose.

No biopsies are made, diagnosis depending on a careful history and close inspection of the lesion. Photographs are taken, and a follow-up system covering five years traces every patient.

No operation is advised on any of these lesions, since the results from X-ray treatment alone are entirely satisfactory. If electrocoagulation is used, post-operative X-ray treatment should follow immediately.

W. W. WATKINS, M.D.

The Fractional Dose Method in the X-ray Treatment of Skin Malignancies. J. M. Martin and C. L. Martin. Southern Med. Jour., June, 1924, p. 391.

EDITORIAL

CASH *VERSUS* CREDIT

"An important readjustment of business conditions, characterized by decreases in industrial and trade activity and lower prices, was declared by the Federal Reserve Board to be under way throughout the United States.

"The Board called attention to reduced earnings by industrial workers, with a consequent curtailment in their buying power and sharp decreases in production. The lowered prices have carried to every commodity except food, which remains almost unchanged.

" 'The considerable expansion of production during the early months of 1924,' the Board said, 'was followed by important curtailment in certain industries in response to a lessened volume of current purchases and a hesitancy on the part of manufacturers in placing forward orders.'

DEMAND FOR CREDIT DECREASES

" 'The recession in business activity has been accompanied, since April, by a decreased demand for credit for commercial purposes, and this, together with the continued inflow of gold imports, has brought about an unusual ease in the money market.'

"In connection with the credit situation the Board said that the earning assets of the twelve Federal Reserve banks was lower at the beginning of this month than at any time for six years. They were approximately $225,000,000 below the figure of the same days last year. The declines in earning assets have been general in all banks, but have been peculiarly large in the New York bank.

REDUCTIONS IN PAY ROLLS

"Practically all important industries showed decreased employment in the last two months as compared with a year ago. The largest reductions in pay rolls were reported in the automobile, iron and steel, and women's clothing businesses.

"The reduced earnings of factory and other industrial workers were reflected in smaller department store sales. Mail order houses also showed smaller movements from their shelves during May and early June.

"Prices of commodities at wholesale dropped. The general level, with the exception of food prices, for May, the Board reported, was 6 per cent below the level of May, 1923.

"Compared with a year ago, the report added, the sharpest price decreases were in building materials, house furnishings, and metals. Prices of farm commodities and foods, which did not advance in early 1923 when most other groups showed increases, suffered much smaller declines."

This has a direct bearing on the practice of medicine in general and roentgenologists in particular, because of the extensive overhead expenses involved, for regardless of how minute the service may be, it always involves an actual expenditure of money and the use of elaborate apparatus.

High food costs and high rents, with lowered employment, mean hard times for the doctor. You probably have noticed that excuses for non-payment of bills are more in evidence now than formerly. The doctor must look more carefuly to his collections than is usually the custom, as economic conditions are unsettled and insecure.

INTERNATIONAL CONGRESS OF RADIOLOGY, LONDON, 1925

PROVISIONAL COMMITTEE: G. W. C. Kaye, M.A., D.Sc.; Robert Knox, M.D.; Stanley Melville, M.D.; E. A. Owen, M.A., D.Sc.; Russell J. Reynolds, M.B., B.S.; R. W. A. Salmond, M.D.; F. Shillington Scales, M.A., M.D.; S. Gilbert Scott, M.R.C.S., L.R.C.P.; Walter J. Turrell, M.A., M.D.; J. E. A. Lynham, M.D., M.R.C.P., and John Muir, B.Sc., M.B., Ch.B.

It is suggested that an International Congress of Radiology shall be held in London in the summer of 1925.

The date proposed for the opening is Tuesday, June 30, the Congress to occupy four days of two sessions each, with subsequent visits to provincial centers.

The house of the British Institute of Radiology will be used as an administrative and social center for the Congress. It is hoped that an International Committee will be formed by a number of leading Radiologists throughout the world and that the Congress will serve to initiate at the Institute a permanent nucleus for international collaboration on Radiology and kindred subjects.

It will facilitate arrangements if Secretaries of Radiological Societies will announce the proposed meeting in their representative Journals and form organizing committees in each country with a view to sending suggestions for the program of proceedings for consideration by the Central Committee.

The provisional committee charged with the preliminary arrangements will meet in London early in September, when it is hoped that replies—at least provisional—will have been received from the societies interested, so that it will be possible to draw up a definite program, and fix the date.

Medical Journals are invited to make a preliminary announcement in an early issue.

All communications should be addressed to the Secretary, International Congress of Radiology, care of the British Institute of Radiology, 32 Welbeck Street, London, W. 1.

The Radiological Society of North America meets in Kansas City, Mo., December 8 to 12, 1924.

The first Executive Session will be held Monday, December 8, at 3 P. M., at the New Baltimore. The annual Counselors' Meeting will be held Monday evening at 7 o'clock. It is hoped this important meeting will be well attended.

The scientific program has been prepared with great care and much labor. It should certainly attract radiologists and clinicians everywhere. Many of the essayists have made great sacrifices to prepare a part of this program, one coming from Denmark and one coming from Germany, especially for this meeting. It is a duty every radiologist owes to himself and the essayists, to attend this meeting. He will be much better equipped if he absorbs a small fraction of the material presented in the program. Many not on the program will have something to add to the discussion.

The Radiological Society of North America has an important mission—the development of the science and art of radiology in North America to the highest standard of efficiency and service. Every radiologist, consciously or unconsciously, plays an important rôle in this development, which either assists or retards. When we get together to discuss our own science, or other related sciences, we make progress. When we stay at home and ignore what our fellows are doing, we are more likely to stay progress. Fellow radiologists, to which class do you belong?

Let us all meet at Kansas City, renew old acquaintanceships and friendships, and better prepare ourselves for the problems we shall be called upon to solve next year.

ROLLIN H. STEVENS, *President.*

TENTATIVE PROGRAM RADIOLOGICAL SOCIETY OF NORTH AMERICA

December 8-12, 1924

Monday, December 8, 3 P. M.—Executive Session (upon arrival of official train)

Monday, December 8, 7 P. M.—Counselors' Meeting

SCIENTIFIC PROGRAM

Dr. H. H. Bowing Rochester, Minn.
"A Radiotherapeutic Method of Management in Cases of Carcinoma of the Cervix Uteri."

Dr. D. T. Quigley Omaha, Neb.
"Etiology, Pathology and Treatment of Cancer of the Cervix."

Dr. Harold Bailey New York
"The Principles of Irradiation Therapy in Cancer of the Uterus."

Dr. Hermann Wintz Erlangen, Germany
"Factors Influencing the X-ray Therapy of Carcinoma."

Dr. J. Thompson Stevens Montclair, N. J.
"Cancer of the Lip and Its Treatment by Means of the Roentgen Rays, Electro-thermic Coagulation and Radium."

Dr. Emil Beck Chicago, Ill.
"Some Interesting Phases in the Treatment of Apparently Hopeless Cases of Sarcoma and Carcinoma."

Dr. Francis Carter Wood New York
"Studies in Dosimetry."

Dr. G. W. Grier Pittsburgh, Pa.
"Treatment of Malignancy of the Eyeball."

Symposium on Carcinoma of the Breast with Consideration of the Pathological, Surgical and Radiological Aspects of the Subject, to be conducted by Dr. Burton J. Lee, of New York City.

1. "Some of the Problems of Pathological Diagnosis of Carcinoma of the Breast."

Surgical Aspect

2. "Difficulties in the Diagnosis of Carcinoma of the Breast." Dr. Malvin B. Clopton, St. Louis, Mo.

By courtesy of the Atchison, Topeka and Santa Fe Railway

Petticoat Lane, Kansas City.

3. "Results Obtained in the Surgical Treatment of Carcinoma of the Breast." Dr. Jabez N. Jackson, Kansas City, Mo.

Radiological Aspect

4. "Results of the Radiological Treatment of Carcinoma of the Breast." Dr. John F. McCullough, Pittsburgh, Pa.

Joint Meeting with the Jackson County Medical Society, Tuesday evening. Demonstration of Tuberculosis of the Lungs. 3-reel film. Dr. L. G. Cole, New York.

Dr. Sanford Withers Denver, Colo.
"Points of Interest in the Operation of Oil-immersed Coolidge Tubes at 200 K.V."

Discussion: Dr. Francis Carter Wood and Mr. Roy Kegerreis.

Dr. Henry G. Schmitz Chicago, Ill.
"Treatment of Tuberculosis of the Genito-urinary Organs with Quartz Light and X-rays."

Dr. W. W. Duke Kansas City, Mo.
"Light Sensitization."

Dr. Axel Reyn Copenhagen, Denmark
"The Employment of Artificial Light in Medicine."

Discussion on Light Therapy to be opened by Dr. A. J. Pacini, Chicago.

Dr. W. E. Costolow Los Angeles, Calif.
"Radiation Treatment of Bone Tumors."

Prof. W. T. Bovie, Ph.D.
Harvard University
"Biological Action of Radiation."

Dr. Maud Slye Chicago, Ill.

Clinical Conference on Thyroid Disease, Dr. E. L. Jenkinson, Chicago, leading.

Radiological aspect:

Dr. A. C. Christie, Washington, D. C.
Dr. R. G. Allison, Minneapolis, Minn.
Dr. R. E. Loucks, Detroit, Mich.

Surgical aspect:

Dr. E. P. Richardson, Boston, Mass.

Medical aspect:

Dr. Robert Preble, Chicago.
Dr. N. C. Gilbert, Chicago.
Dr. J. L. Tierney, St. Louis, Mo.
Dr. J. L. Miller, Chicago.

Wednesday Evening

Banquet and Convocation for the presentation of Honorary Fellowship diplomas and medals. Presidential address.

Dr. Samuel B. Childs Denver, Colo.

Dr. Sherwood Moore
Washington University, St. Louis
"Radiological Aspects of Certain Bone Marrow Diseases."

By courtesy of the Atchison, Topeka and Santa Fe Railway
Street Scene in Residential Section, Kansas City.

Dr. Charles G. Sutherland
Mayo Clinic, Rochester, Minn.
"Charcot Joints."

Clinical Conference on Bone Tumors, to be conducted by Dr. Henry W. Meyerding, of Rochester, Minn.

Dr. Frank D. Dickson Kansas City, Mo.
"Radiographic Types of Osteomyelitis."

Dr. Willis Campbell Memphis, Tenn.
"Bone Syphilis."

Dr. William C. MacCarty Rochester, Minn.
"Pathological Types of Bone Tumors."

Dr. H. W. Meyerding Rochester, Minn.
"Multiple Myeloma."

Roentgenographic and Orthopedic Clinic:

Dr. P. M. Hickey, Ann Arbor, Mich.
Dr. Frank Dickson, Kansas City, Mo.

Cases will be presented illustrating bone and joint pathology. Discussion of the X-ray findings by Dr. Hickey and demonstration of the clinical features by Dr. Dickson.

Dr. J. D. Southard Fort Smith, Ark.
"X-ray Treatment of Bone Tuberculosis."

Gall Bladder Symposium:

Dr. B. R. Kirklin, Muncie, Ind.
Dr. Robert A. Arens, Chicago, Ill.
Dr. R. D. Carman, Rochester, Minn.
Dr. C. D. Enfield, Louisville, Ky.

Dr. B. H. Nichols Cleveland, Ohio
"Differential Diagnosis of Gall Stones and Kidney Stones."

Dr. J. H. Dempster Detroit, Mich.
"Undergraduate Instruction in Radiology."

Dr. Russell D. Carman and Dr. William F. Braasch Rochester, Minn.
"The Roentgenologic and Pyelographic Diagnosis of Renal Tumors."

Dr. Geo. Kessler St. Louis, Mo.

Mr. H. N. Beets
Michael Reese Hospital, Chicago

Dr. R. H. Millwee Dallas, Tex.

Dr. J. C. Dickinson Tampa, Fla.
"X-ray Findings in Hepatic Abscesses of the Amebic Type."

Dr. Max Kahn and Dr. Martin Sloan Baltimore, Md.
"An X-ray and Clinical Study of Some Pulmonary Lesions."

Dr. I. S. Trostler and Dr. Robert H. Hayes Chicago, Ill.
"A Pathognomonic Radiographic Finding in Early Pulmonary Tuberculosis."

Dr. L. R. Sante St. Louis, Mo.
Symposium on Non-tuberculous Diseases of the Chest.

Dr. L. T. LeWald New York
"Tumors of the Chest."

Dr. W. W. Watkins and Dr. Harlan Page Mills Phoenix, Ariz.
"X-ray Evidence of Secondary Infection in Pulmonary Tuberculosis."

Symposium on Tuberculosis of the Lungs, to be conducted by Dr. W. W. Wasson, Denver, Colo.

Dr. William Snow Miller Madison, Wis.
"Anatomy of the Lungs."

Dr. H. Kennon Dunham Cincinnati, Ohio
"The Pathology of Tuberculosis in the Human."

Dr. James J. Waring Denver, Colo.
"The Relationship of Radiological Diagnosis of Tuberculosis of the Lungs to Clinical Diagnosis."

Discussion: Dr. B. H. Orndoff and Dr. A. W. Crane.

Dr. Adolph Hartung Chicago
"Diverticula of the Duodenum."

Dr. John T. Murphy Toledo, Ohio
"Osteomyelitis of the Mandible Following Treatment for Pyorrhea."

Clinical Symposium on Dental Radiography:

Dr. Boyd S. Gardner, Rochester, Minn.

Dr. Frederick Molt, Chicago, X-ray Diagnosis.

Dr. W. W. Duke, Kansas City, Medical Aspect.

Dr. Boyd S. Gardner, Rochester, Surgical Aspect.

Dr. R. L. Haden, Kansas City, Pathological Aspect.

The Iowa X-ray Club held a meeting at the Iowa University Hospital, October 11, 1924. The following essayists contributed to the program: Dr. Edwin C. Ernst, of St. Louis; Dr. Henry Schmitz, of Chicago; Dr. Sherwood Moore, of St. Louis; Dr. R. D. Carman, of Rochester, and Dr. E. H. Skinner, of Kansas City.

A man calling himself George Saunders, George Warren and other aliases, 220 pounds, 5 feet 8 inches tall, about forty or fifty years old, is calling on X-ray men, giving checks on some distant bank signed by a brother. These checks are of larger amount than the X-ray bill, and he pockets the difference. Checks are returned as worthless. This man claims to be a stock-raiser specializing in thoroughbred cattle, and has the appearance of having lived in the open. He has scars on a hand and his left elbow.

Dr. med. J. Wetterer, of Mannheim, Germany, author of *Handbuch der Roentgen und Radium-Therapie*, now in its third edition, is preparing an international index or register of all radiologists, to be known as the *Index Radiologorum*. The names of the physicians will be given in alphabetical order (subdivided in countries and towns), addresses, kind of principal professional occupations, kind of apparatus at disposal, and other valuable details.

It will be published in English, French, German, Italian and Spanish. Every reader will be able to find the contributions of interest to himself in other languages, by a special key-index.

The Editor desires to have the net profits accruing from the sale of the Index and the advertising in the same, serve in part as an international benefit fund for the families of radiologists who may be in distress.

The Editor proposes to hand this fund over to an international committee, an appointed notary or public trustee, who would be entrusted with it.

Each country is to nominate several members of this committee, which, together with the Editor, shall decide upon the use of the fund. He has asked the following gentlemen to become patrons of the fund in this country: Drs. J. T. Case, A. C. Christie, W. D. Coolidge, G. E. Pfahler, A. J. Ochsner, Douglas Quick, and R. H. Stevens.

Prof. Gosta Forssell, of Stockholm, Sweden, Editor of *Acta Radiologica* and Professor of Radiology in the University of Stockholm, and Prof. Heyman, also of Stockholm, addressed the Detroit X-ray and Radium Society on Saturday, Sept. 13.

Dr. Forssell spoke on the rôle of the mucous folds of the gastro-intestinal canal. He proved by beautiful demonstrations how the rugæ arrange themselves in normal and pathological conditions. They are largely responsible for the valve at the pylorus; also, they automatically arrange themselves in folds to form a valve of a gastro-jejunostomy. They are responsible for the contour of ulcer of the stomach where niches are formed, etc., the latter by no means being always of the dissecting type. They are also present in the duodenal bulb and are responsible for the deformity seen here in ulcer.

Prof. Heyman, Professor of Gynecology in the University of Stockholm, gave statistics of results of treatment of cancer of the uterus, over several groups of years, showing gradual improvement in technic and corresponding improvement in results. He does not find the combination of X-ray and radium as satisfactory as radium alone.

In a lecture, "Bakteriologie und Patentrecht," by Dr. Fritz Warschauer, Berlin, Patent Agent, delivered at the recent meeting of German scientists and physicians at Innsbruck, bacteriology has been, for the *first* time, discussed minutely from the point of view of the German patent right. The lecturer showed by numerous specifications that the German Reichs-Patentamt has, in acknowledging a justified claim, granted patents for bacteriological processes. According to former decisions, an invention was considered to be patentable in Germany only if it related to mechanical or chemical treatment or working up of raw materials, *viz.*, if by technical means a technical effect was obtained. In practice, however, the Reichs-Patentamt has given up this antiquated notion, probably in consideration of the development of bacteriologic science, and by a recent decision it has expressly acknowledged that processes and methods are patentable which utilize the vital proceedings of Nature.

A list compiled by the lecturer showed that many famous scientists and leading chemical factories are inventors and proprietors of bacteriological patents.

OBITUARY

Carl F. Little, Cincinnati, Ohio; Miami Medical College, 1900. Member of the Radiological Society of North America and of the American Medical Association; Assistant Professor of Radiology in the Cincinnati College of Medicine; resident roentgenologist at the Cincinnati General Hospital; roentgenologist at St. Elizabeth Hospital, Covington, Ky. Age, 46; died September 8, 1924.

The members of the Radiological Society of North America wish to express their sorrow at the loss of their fellow-member, Dr. Carl F. Little.

BOOK REVIEWS

This month we choose to consider *Pneumoperitoneal Roentgen-ray Diagnosis*, by Dr. Arthur Stein and Dr. William Stewart.

PNEUMOPERITONEAL ROENTGEN-RAY DIAGNOSIS (A Monograph, with Atlas), by Arthur Stein, M.D., F.A.C.S., Associate Gynecologist, Harlem Hospital and Lenox Hill Hospital, New York City, and William H. Stewart, M.D., F.A.C.P., Roentgenologist, Harlem Hospital and Lenox Hill Hospital, New York City. Published by the Southworth Company, Troy, N. Y. Price $16.00.

When one considers the contrasting possibilities of air upon the roentgen negative, one is not surprised to find that its artificial injection into every body cavity or viscus has been accomplished. What is surprising though, is the fact that it took about twenty years to run the gantlet of pneumatic radiography. The first spectacular and spontaneous exhibition of pneumo-radiography probably was a pneumothorax. Think of the thrill of one's first observation of a pneumo-pyo-thorax! That was in the nineteenth century; and now think of the thrill of viewing the ventricles of the brain after an air-injection, twenty-five years later.

Stewart and Stein take you through the history, bibliography and practice of this balloon-tire roentgen industry in this beautiful book produced by the Southworth Company. Their discussions are not limited to pneumoperitoneum, although their illustrations are. There are nearly one hundred pages of text and bibliography. The beautiful photographic illustrations (36 in number) are exquisite productions that correspond in excellence to anything ever published. But all of Southworth's Atlases are similar in execution. You should be familiar with Case's volumes upon Gastro-intestinal Radiology and Dunham's Pulmonary Studies. Both of these productions, together with Beck's volume upon Stereoscopy and Localization will remain always as classical American roentgen literature. Think of how libraries will search for and hoard these gems, some day!

These volumes by Southworth are essentially expensive, but necessarily so. They cost more than any other medical volume to produce and their sale is limited. All of which makes them the more desirable to the student and the collector of roentgen literature.

Let us strike out at a tangential subject to radiology, although a basic factor in the study of medicine, and introduce the reader to *Vital Statistics*, by Falk.

THE PRINCIPLES OF VITAL STATISTICS, by I. S. Falk, Ph.D., Department of Public Health, Yale University. Illustrated. Philadelphia and London, W. B. Saunders Company, 1923. Price $2.50.

This small volume "describes the more important procedures and sources of information which are commonly utilized in statistical inquiries and indicates certain outstanding evidences and conclusions which statisticians have derived and which are of interest to students and workers in public health." Last month we reviewed a similar book by Raymond Pearl which may be considered as dealing with the higher mathematics of vital statistics and medical biometry. This smaller volume of Falk's is a kindergarten course in comparison and therefore the more valuable to physicians and public health workers.

Do you want to know why you should read this book? Do you want to know the what, how, when and where of vital statistics? *Vital Statistics* is the logic of the statistical method applied to the fundamental events of human lives—the bookkeeping of birth, health, disease and death. The radiologist uses vital statistics in the accurate recording of case histories, with the course and outcome of treatment and the analytical evaluation of roentgen methods in diagnosis and therapy. The health officer, public health nurse and the other workers in preventive medicine use vital statistics to provide the gauges by means of which they measure the need for any particular kind of work as well as the suc-

cess and failure of their efforts. They are used to finding out what is the matter with a community's health. They are the record of a population's composition with respect to age, sex, race proportions, births, deaths, sickness, recoveries, *et cetera*.

Therefore, Falk uses the following chapter headings: Vital Statistics: What Are They?—The Census and the Composition of the Population—Births and Birth-rates —Infant Mortality—Morbidity (Sickness in the Community and the Incidence of Physical Defects)—Mortality—Causes of Death—The Interpretation of Statistics—Statistical Errors and Fallacies.

The author quotes Quetelet's Rules: "1. Never have preconceived ideas as to what the figures are to prove. 2. In a statistical study never reject a number merely because it varies considerably from the average or because it appears to contradict what you expect. 3. Try to weigh and record *all* the possible causes of an event, and do not attribute to one what is really the result of the combination of several. 4. Never compare data which have nothing in common."

The paragraphs upon the Interpretation and Errors of Statistics are especially interesting, for they are illustrated by anecdotes of famous errors.

Statistics are such an essential in preventive medicine that we can easily engage ourselves with this second edition of Kenelm Winslow's *Prevention of Disease in the Individual.*

THE PREVENTION OF DISEASE IN THE INDIVIDUAL, by Kenelm Winslow, B.A.S., M.D., Attending Physician to Seattle City Hospital and King County Hospital, Washington; formerly Assistant Professor of Comparative Therapeutics at Harvard University; formerly Surgeon to Newton Hospital; recent Vice President of the American Association for the Study and Prevention of Infant Mortality; Author of "The Production and Handling of Clean Milk," etc. Second Edition, thoroughly revised. Philadelphia and London, W. B. Saunders Company, 1924.

When we consider that there are 800,000 deaths every year in this country from preventable disease, we should be interested in the study of this big situation. If an ounce of prevention is worth a pound of cure we are vitally concerned in this sixteen-to-one ratio of preventive and curative medicine. Who was the first great preventor? Jenner, with vaccination. Then the anti-toxins of Pasteur, Koch, Behring, and Wright's vaccination against typhoid. Consider the abortive specific therapy of malaria and syphilis. Don't overlook the influence of eliminating focal infections *via* tonsil, tooth and sinus. And now the allergistic phenomena in hay-fever, asthma, eczema, urticaria, etc. And the latest dramatic incident in preventive medicine is insulin. Why did vitamins, hook-worm, pellagra and beri-beri escape our chronological sequence?

You (being an educated physician) will be able to supply many more features in modern preventive medicine without reading Winslow's book. But it is a good book for the laity because it enables the patient to co-operate intelligently with his doctor. It does not aim to make the patient his own doctor. As Charles H. Mayo says in the preface, "The presentation of the wonderful advances of modern medicine here given, together with carefully considered rules for daily living in order to preserve health, is offered to those who desire them, not that they may become physicians by reading this matter, but that, from their wider knowledge of science, they may be better citizens."

It is late. In fact, it is quite early. Still this book upon Pasteur keeps one awake with infinite ease.

PASTEUR: THE HISTORY OF A MIND, by Emile Duclaux, late member of the Institute of France, Professor at the Sorbonne and Director of the Pasteur Institute. Translated by Erwin F. Smith and Florence Hedges, Pathologists of the U. S. Department of Agriculture. Illustrated. Philadelphia and London, W. B. Saunders Company, 1920.

The original book is an appreciative study of Pasteur by his pupil and successor, Duclaux. The translators (Smith and Hedges) have written an exceedingly interesting introduction, carrying anecdotal and illuminating incidents in the life of Duclaux. While Pasteur was the originating mind, Duclaux was the organizer. Block neatly says, "To this great foundation (the Pasteur Institute of Paris) Pasteur bequeathed a scientific tradition, but it was Duclaux who created its soul."

Duclaux was associated with Pasteur from 1858 until Pasteur's death in 1895. It was but natural that Duclaux should write an appreciation of Pasteur, which he chose to entitle, "Pasteur: Histoire d'un Esprit." "In it the Pasteurian discoveries unfold in their harmonious development with, perhaps, a little more amplitude and coherence, a little less originality and vivid profundity than in the reality. He who has read this book will understand the reach of the greatest scientific movement in the nineteenth century, and at the same time will appreciate how slowly the truth unfolds and how often genius itself loses the thread of the labyrinth in traversing it for the first time. Now that we have made of this Dædalus one of the boulevards of the modern mind, it is good to recall what obstacles and what errors then rendered it almost impracticable. The one who knew best the founder of microbiology has written of the book as follows: 'After having read this analysis of his work, we understood Pasteur better, and find him greater still' (Dr. Roux). We understand better both Pasteur and Duclaux. Pasteur followed his idea as the Magi their star. 'He was a priest; priest of the idea,' said his successor. In him, instinct or rather bold intuition, dominated reason. 'Therefore,' says Duclaux, 'He saw with a new vision, and justly.' His disdain for traditional knowledge and philosophical speculations was scarcely concealed. Trusting only in experiments, he knew how to outstrip them and more than once went far beyond them. 'That which puts him outside of comparison is the fact that he *loved great horizons,* knew how to discover them, and to make himself a part of them; that *he saw at a distance* and through the mists, more clearly than anyone else, the high summit he must attain to dominate the unknown and Promised Land. This was his rare gift and the secret of his power. But once seen, he had wings to reach it no more than we. One might believe, considering the originality, the simplicity, and the unexpected in his solutions, that they were spontaneous and in the nature of happy discoveries. I do not know whether there ever are any such easy discoveries, accomplished without effort and by a sort of divination. Such surely was not the case with Pasteur's. If he was a discoverer it was first of all because he was a silent man and an obstinate one.' "

Duclaux's Author's Preface offers this poignant paragraph: "On opening this volume, someone will say: 'How is it possible to make the history of a mind?' One could write an exact history of a man: He has spoken, he has written, he has done things; we know where to lay hold of him and judge him. But a mind, especially that of a scientific man, is a bird on the wing; we see it only when it alights, or when it takes flight. When it is the mind of a genius, like Pasteur, the difficulty seems almost insoluble. We may, by watching closely, keep it in view, and point out just where it touches the earth. But why does it alight here and not there? Why has it taken this direction and not that in its flight toward new discoveries? If it were possible for you to know this and tell us, Pasteur would no longer be a genius, escaping analysis; and if you do not tell us, you will merely draw up a report, not write a history."

Duclaux follows Pasteur through the succeeding steps of his life, from his "Works on Crystallography" to "Lactic and